JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES
VOL. III DECEMBER 19, 1913 No. 21

TERRESTRIAL MAGNETISM.—*Preliminary results of a first analysis of the sun's general magnetic field.*[1] L. A. BAUER, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

The question whether the sun, like the earth, is surrounded by a magnetic field, received renewed interest from Hale's certain detection in 1908 of magnetic fields in sun-spots, by means of the effect of magnetism on light discovered by Zeeman in 1896. Previous investigators had shown that for a direct magnetic effect attributable to the sun to be readily measurable on the earth, the sun's magnetic moment would have to reach a very large figure. Accordingly our surmises hitherto have had to be confined exclusively to certain phenomena exhibited by the coronal streamers and motion of solar prominences, and by polar lights and magnetic perturbations.

It is a source of extreme satisfaction, therefore, that the means were given Hale to institute a *direct* attack and undertake the systematic detection of a possible general solar magnetic field, employing the same method which had proved successful in the case of sun-spots. As the probable field-intensity *now* was on the order of about one-tenth to one-hundredth of that encountered in the spots, the instrumental difficulties seemed almost insuperable. The observed displacements of the spectrum lines, to be ascribed to the sun's general magnetic field, are, in fact, found to be so small that but for the superior instrumental appli-

[1] Presented before the Philosophical Society of Washington, November 22, 1913. To be published more fully in J. Terr. Mag. and Atmos. Elec., **19**. 1914.

ances and refined methods employed, they would have been regarded as falling within the limits of error of spectroscopic work. After a very laborious investigation extending over several years, in which various persons took part, and instrumental appliances were employed such as are only to be had at the Mount Wilson Observatory, Hale felt justified in making some announcement of the results obtained. His report on his "preliminary results of an attempt to detect the general magnetic field of the sun" was published in the July 1913 number of the *Astrophysical Journal.*[2]

All observations have been made thus far with the slit of the spectroscope set on the sun's central meridian. The measured displacements, suffered by the lines of the solar spectrum when the glowing vapors, from which they originate, pass thru the magnetic field, are those due almost exclusively to the component of the field at right angles to the sun's axis of rotation. The reason for this is a two-fold one: First, the terrestrial observer of solar phenomena is nearly always in the plane of the solar equator so that his line of sight is practically always perpendicular to the sun's axis of rotation. Twice a year, about December 5 and June 3, it is exactly so, and midway between these dates the maximum deviation from perpendicularity is but 7°15′. Secondly, the certain detection of the small displacements must at present be confined, because of the comparative weakness of the field, to the Zeeman effect obtained when looking *along* the lines of magnetic force. The detection of the effects at right angles to the lines of magnetic force, and the possibility of thus measuring also the component of the sun's magnetic field parallel to the axis of rotation, appears almost hopeless. Altho the solar magnetician is therefore not able at present to map the magnetic forces prevailing over the sun with the same completeness and definiteness as can be attained with respect to the earth's magnetic field, nevertheless, much has already been accomplished.

[2] See also his preliminary note in J. Terr. Mag. and Atmos. Elec., **17**: 173. 1912.

In Hale's published report, the Zeeman displacement which had been detected with sufficient certainty, was tabulated for various heliographic latitudes for the three lines: λ5812.139, λ5828.097 and λ5929.898, all of which probably originate at comparatively low levels on the sun. The present analysis is based entirely on these published data and, since these are designated by Hale as preliminary ones, the results derived accordingly from this analysis must be regarded as wholly preliminary and as likely to be superceded by later ones which may be based upon more extensive observations. The prime purpose here has been to ascertain if precisely the same method of analysis be employed for the solar magnetic data, as for the terrestrial magnetic data, some indications, at least, are obtained to show whether or not the magnetic fields of the two bodies follow somewhat analogous laws. In order to obtain strictly comparable data, it was necessary to make at the same time a fresh analysis of the earth's magnetic field on the basis of the same magnetic component involved in the solar data, and applying to the region 60° north to 60° south.

The chief results deduced from this first analysis of the sun's general magnetic field are:

1. The magnetic axis, as determined from the published data between the parallels 60° north to 60° south and for the four series of observations between January 1912 to February 1913, is found to be inclined, for the sun, 9° to 12° to the axis of rotation. The same angle of inclination for the earth was 11°.6, in 1885.

2. The sun's magnetic field is asymmetrical about the equator in much the same manner and in the same direction as is that of the earth. It is quite possible that the sun's actual magnetic poles, or equivalent points, as in the case of the earth, will be found not to be diametrically opposite each other.

3. The analysis determined four instants, distributed over a year, when the north end of the sun's magnetic axis was on the central meridian. Since a whole number of rotations of the sun must have occurred during the intervals between the four instants, it was possible to determine a period of rotation which applies, perhaps, to the sun as a whole, instead of to the surface, as is the case with the methods hitherto used. The synodic period of nearly 33 days which represented the present magnetic data best, differs considerably from the period usually regarded as the solar rotation period. It will therefore be highly

important, from a cosmical standpoint, to test the new period as soon as additional series of observations are available. It may also play an important part in the discovery of the cause of the sun-spot cycle, however, the period obtained must be regarded at present as but a preliminary one.

4. It is found that the solar magnetic field is as complex as that of the earth and that the distorting or disturbing systems which are superposed upon a primary, simple magnetic field follow laws very similar to those disclosed in the study of the terrestrial magnetic field. Thus, for example, the plane containing the magnetic axis of the sun is displaced in passing from the northern to the southern hemisphere in precisely the same direction, eastward (in the direction of rotation), as was found to be the case with the earth's magnetic axis. Accordingly, to give the requisite precision to the term "magnetic axis," the region from which it is determined must be carefully stated, as well as the method employed for fixing its position.

The close analogies that thus appear to exist between the magnetic field of the sun and of the earth, coupled with the fact disclosed by Hale that the magnetic polarity of the sun corresponds to that of the earth, may possibly indicate, since the direction of rotation of the two bodies is the same, that the origin of both magnetic fields will have to be referred finally to similar causes. In any case, the fact that the sun's field turns out to be as complex and as irregular as that of the earth and that these apparent irregularities follow similar laws for both bodies, would seem to strengthen the conclusion already reached in the investigation[3] of the terrestrial magnetic field, that it may not be necessary to refer the cause of the non-coincidence of the magnetic axis with the axis of rotation chiefly to heterogeneity of structure of the bodies under discussion.

[3] A consistent theory of the origin of the earth's magnetic field. This Journal, **3**: 1. 1913, and On the origin of the earth's magnetic field (Phys. Rev. N.S., **1**: 256. 1913.

RADIOTELEGRAPHY.—*Further comparison of arc and spark radio transmission.* L. W. AUSTIN, U. S. Naval Radio Telegraphic Laboratory.

In order to make a comparison of the relative desirability of arc and spark transmission under summer conditions, a test was carried on between the Arlington station and Colon during the months of July and August of the present year. This time was chosen for the test on account of the fact that the signals are weakest at this period of the year, while at the same time the atmospheric disturbances are the strongest, so that the test may be considered as carried on under the most trying conditions. Hitherto all the long distance tests carried on by the Navy Department in connection with Arlington have been made during the winter months, when atmospheric disturbances are at a minimum and all conditions are favorable to long distance transmission. It was especially wished to make a comparison of the relative desirability of arc and spark transmission under summer conditions in order to determine whether the conclusions favorable to the arc, which had been drawn from the Arlington-Salem tests, would be supported.

For this work a 100 k.w. Poulsen arc belonging to the Universal Radio Syndicate was available for comparison with the regular rotary gap set of the Arlington station. The regular experiments began on July 25. The distance from Arlington to Colon is 1780 nautical miles. From the formula deduced from the Brant Rock experiments, the Arlington signals, at a wave length of 4000 meters, should be faintly audible at this distance, using a sensitive crystal detector and an antenna 200 feet high. As a matter of fact, the signals are just below audibility with ordinary detectors, as is shown from their strength on the more sensitive ticker. This fact may be due to the passage of the waves over Cuba, or to other conditions of transmission in this portion of the world.

The receiving work at Colon was done by Chief Electrician Meneratti, assistant at the Naval Radio Laboratory. The receiving apparatus used consisted of a Federal receiving set, which

is especially efficient at the longer wave lengths, a slipping contact ticker, and a Fessenden heterodyne. The regular antenna of the Colon station, 180 feet high and of about 0.004 m.f. capacity, was used for the work. The arc signals were sent out from Arlington at wave lengths of 4000, 5000, 6000 and 7000 meters. Two wave lengths were used with the spark, 3500 meters and 2500 meters. The latter, however, proved so unsatisfactory at this distance that its use was abandoned after the first few days.

On account of the continuous atmospheric disturbances quantitative comparisons were of little value. The following table gives the number of schedules sent at the various wave lengths, and the corresponding number received:

	WAVE LENGTH	SENDING CURRENT AMP.	TOTAL SCHEDULES		SCHEDULES HEARD	
			Day	Night	Day	Night
	m					
Spark	3500	104	9	0	7	0
Arc	4000	52	9	4	7	4
Arc	5000	60	0	4	0	4
Arc	6000	70	6	0	2	0
Arc	7000	78	3	7	3	7

The table shows that the best results were obtained with the arc at 7000 meters, every schedule being successfully received. The same is true of the 5000 meter arc waves, but in this case all the work was done at night which prevents its being properly compared with the other schedules. The 4000 meter arc and the 3500 meter spark waves, which may be fairly compared, were received with the same degree of regularity and were of approximately the same strength as compared on the slipping contact ticker. In this connection it must be remembered, as will be explained later, that while 90 per cent of the spark schedules were weakly audible on the heterodyne or ticker, practically none of the messages were readable. It appears from the report that 50 per cent of all the arc messages sent at the various wave length, that is, 65 per cent of the arc schedules heard at all,

would have been completely readable by double repetition. The very poor showing of the 6000 meter wave, compared with the 4000 and 7000 meter waves, is probably due to a defect in the receiver at this wave length.

One of the most interesting portions of the work was the study of the behavior of the ticker and heterodyne under the conditions of continuous atmospheric disturbance at Colon. The reports indicate that the heterodyne is somewhat more sensitive than the ticker, but that the difference is not very great. With spark signals the note produced by both is unmusical and difficult to distinguish from the atmospherics, and both are inferior to a good crystal detector in receiving weak 500 cycle signals thru continuous atmospherics. With arc signals, however, the case is entirely different. Here the slipping contact ticker produces the same rustling sound as in the case of the spark, but the heterodyne produces a musical note of any pitch found most suitable for reading thru the disturbances.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted thru the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

GEOPHYSICS.—*The hydrothermal formation of silicates, a review.* GEORGE W. MOREY and PAUL NIGGLI. J. Am. Chem. Soc., **35**: 1086–1130. 1913.

This is a discussion of the theoretical principles underlying the behavior of water-silicate systems at temperatures ranging up to 500°, followed by an annotated bibliography in which are assembled all of the data relating to hydrothermal syntheses. These data unfortunately afford practically no reliable quantitative information; qualitatively, even, they leave much to be desired, for many minerals have been obtained but once by a given investigator, in a manner which was not reproducible and under conditions which were not specified. The minerals which have been most commonly obtained are chiefly those which are stable—or at any rate phanerostable—over a wide range of conditions; for example, quartz and the feldspars. In all cases the crystals obtained are very small, so that accurate chemical analysis is usually out of the question; their identification by optical methods may even be doubtful.

Hydrothermal syntheses, like the paragenetic relationships investigated by Van't Hoff, are determined by the solubility relations of all the possible solid phases which may be formed from the components present in the solution, even altho the concentration of these components in the solution is vanishingly small. Many of the reactions are, without doubt, practically restricted to the solid phase, altho they take place thru the medium of the solution. These solubility relationships are thus not simple; but study of the question is further complicated by the frequent appearance of metastable phases, which again is coördinated with the rates of the various possible reactions. Now, as is well known, rates of reaction are often affected very greatly by factors which in other respects are of altogether minor importance; hence slight differences, e.g., in the composition, or even in the texture or fineness of grain, of the initial solid phase—may exert considerable influence on the

result. These considerations serve to show that there may in certain cases be difficulties in the way of always being able to reproduce a given result; in order to do this in any case, it is necessary to control carefully the amount of water relative to the volume of the containing vessel (the degree of filling), the temperature, and, if possible, the pressure also. The critical point of water is only a secondary factor in determining the nature of the product, its influence being effected principally thru the change in concentration of the solvent (liquid or fluid) in the neighborhood of the critical point.

The thoro investigation of hydrothermal syntheses is beset with many difficulties, apart from the technical problems inherent in operating on heterogeneous systems within closed bombs at high temperatures. Nevertheless our knowledge of the real relationship of these minerals can be advanced materially if care is taken to control the factors involved, the most important of which are the initial composition of the system (including therein the relation between the amount of water and the volume of the bomb) and the temperature. G. W. M. and P. N.

PHYSICS.—*Densities at high temperatures.* ARTHUR L. DAY, R. B. SOSMAN and J. C. HOSTETTER. Am. Jour. Sci. (4). 1913.

The existing and rather conflicting data on the volume change of rocks on fusion are reviewed briefly. A method and apparatus is described for the determination of the specific volume of metals or of solid or fused silicates from 200° to 1600°. The basis of measurement is the expansion of artificial graphite, which was determined from 20° to 1500°. Volume curves are given for tin, lead, and the eutectic of lead and tin. Measurements were made on quartz up to 1600°. The volume of quartz increases more and more rapidly as 575° is approached. At this point the inversion takes place to the high-temperature form, whose volume decreases slightly with rising temperature. Between 950° and 1250° gasses are given off. Above 1300° the volume is increased greatly by the formation of cristobalite. Granite shows the same form of curve as quartz. Above 500°, however, it is not possible to obtain its true volume expansion because of the shattering and permanent dilation due to unequal expansion of the minerals and to escape of gasses. The same is true of crystalline diabase.

The curve of glassy diabase can be obtained, however. The glass crystallizes with contraction of volume at about 900°, then begins to fuse again at about 1150°. On cooling, the liquid again crystallizes with contraction. This behavior explains completely the results of Barus,

which have been widely quoted. A recalculation of his data on the basis of redetermination of his fundamental volume show them to be in good agreement with the new measurements. The bearing of these data upon the occurrence of "floated" slabs of rock in the Palisade diabase is discussed. A. L. D.

CHEMISTRY.—*A method for the determination of magnesium in calcium salts.* J. C. HOSTETTER. J. Am. Chem. Soc. 1913.

The usual methods for the determination of magnesium in the presence of calcium are not applicable when the latter element amounts to as much as 1000 times that of the magnesium. The essential feature of the method here presented is the concentration of the magnesium into a precipitate containing but a small amount of calcium. This concentration is effected by precipitating $Mg(OH)_2$ with a slight excess of solid $Ca(OH)_2$. The magnesium in this precipitate is determined as pyrophosphate after removal of the calcium by two oxalate precipitations. Determinations in some 30 highest-grade calcium salts show, generally, far more magnesium than reported by the makers.

J. C. H.

PHYSICAL CHEMISTRY.—*The phenomena of equilibrium between silica and the alkali carbonates.* PAUL NIGGLI. J. Am. Chem. Soc., **35**: 1692–1727. 1913.

This is a record of an experimental investigation of the equilibrium between silica and melted alkali carbonate, at temperatures of 900–1000° and under a pressure of 1 atm. carbon dioxide. A series of experiments were made with the carbonates of potassium and sodium, and a few with lithium carbonate. The systems R_2O-SiO_2-CO_2 (R = K, Na, Li), under the above-mentioned conditions behave similarly on the whole, and differ only in details. Silica added to alkali carbonate is transformed into silicate as long as any carbonate remains. In the melts there is equilibrium between carbonate and pairs of silicates, as follows:

I $K_2CO_3 + K_2Si_2O_5 \rightleftarrows 2K_2SiO_3 + CO_2$

II $Na_2CO_3 + Na_2SiO_3 \rightleftarrows Na_4SiO_4 + CO_2$

III (presumably) $2Li_2CO_3 + Li_4SiO_4 \rightleftarrows Li_6SiO_6 + 2CO_2$

The solid phases, which separate from the melts, consist of silicate or carbonate, but contain no free silica until the proportion of silica exceeds that corresponding to the higher silicate. The amount of carbonate depends only on the ratio R_2O/SiO_2, when external conditions are constant; when this ratio becomes identical with that of the silicate

richer in silica, the melt is free from carbon dioxide. In each case the compound containing more silica is the poorest in silica which can be prepared pure at the particular temperature merely by putting together carbonate and silica. Moreover, rise of temperature, the pressure remaining constant, favors the lower silicate.

The study of systems of this type is important because their behavior serves as a simple prototype of that of the magma, which is a highly complex system containing both volatile and non-volatile components. The so-called "mineralizers" are merely volatile components; the effects of their presence differ only in degree from that of the other components. The main difference is due to the vastly greater effect of changes of pressure and of temperature on the concentration (in the melt) of the volatile component, by reason of the close relation of the concentration to that of the gas phase itself. In consequence of this, there is a "mobility" of equilibrium which is characteristic of the magma and without doubt very closely associated with many aspects of its behavior, e.g., with the likelihood of eruption, differentiation, etc. P. N.

MINERALOGY.—*The melting phenomena of the plagioclase feldspars.* N. L. Bowen. Am. Jour. Sci. (4), **35**: 577–599. 1913.

The method of quenching was applied to the determination of the melting intervals of pure, artificial plagioclase feldspars. It was found possible to determine accurately the temperatures of beginning of melting (solidus) for compositions ranging from pure An to Ab_3An_1 and of completion of melting (liquidus) for the range An-Ab_8An_1. Very pure natural material, Bakersville oligoclase was used to determine the point on the solidus corresponding to its composition. Similar material, Amelia County albite, served to fix the melting point of albite. The results of this work are summarized below:

COMPOSITION	TEMPERATURE OF BEGINNING OF MELTING. SOLIDUS	TEMPERATURE OF COMPLETION OF MELTING. LIQUIDUS
An	1550° ± 2°	1550° ± 2°
Ab_1An_3	1465° ± 4°	1521° ± 2°
Ab_1An_2	1372° ± 4°	1490° ± 2°
Ab_1An_1	1287° ± 4°	1450° ± 2°
Ab_2An_1	1205° ± 5°	1394° ± 2°
Ab_3An_1	1175° ± 8°	1362° ± 2°
$Ab_{77.5}An_{22.5}$	1158° ± 5°	
Ab_4An_1		1334° ± 2°
Ab_5An_1		1265° ± 3°
$Ab_{88}An_2$	1100° ± 10°	

It was also found possible in several instances to determine the composition of the liquid phase, present at temperatures within the melting interval, by measuring the refractive index of the quenched glass. Thus points on the liquidus were determined by an independent method and were found to be in excellent agreement with the results of the temperature method.

In the theoretical discussion, equations are developed which express the concentrations on the liquidus and solidus at any temperature in terms of the melting temperatures and latent heats of melting of the two components. The experimental results therefore make possible the calculation of the latent heat of melting of anorthite and of albite. The calculated values are 104.2 calories per gram for anorthite and 48.5 calories per gram for albite and these values remain practically constant for all ranges of composition. The calculated latent heat of anorthite is in excellent agreement with the figure found by direct measurement, 105 calories per gram. No direct determinations of the latent heat of albite have been made. It is shown that if these values of the latent heats are taken and liquidus and solidus curves calculated, the resulting curves pass very close to the experimentally determined temperatures (within the limits of error of the temperature measurements). It is also shown that values of the latent heats differing from these by as little as 10 per cent will not give a like result. This extreme agreement with the requirements of theory and its bearing on certain theoretical questions is discussed.

The geological significance of the complete solid solution of the feldspars is considered, as well as the extent to which zoning may occur under favorable conditions and the consequent great range of temperature thru which plagioclase may crystallize. N. L. B.

PETROLOGY.—*Graphical methods in microscopical petrography.* FRED EUGENE WRIGHT. Am. Jour. Sci. (4), **36**: 509–539. 1913.

Experience in microscopical petrography has shown that the results furnished by graphical means are, as a rule, sufficiently accurate and in accord with the quality of the data of observation. Graphical methods in petrography serve three purposes: (1) to solve certain equations, (2) to represent data of observation, and (3) to picture certain important crystallographical and optical relations. In all these cases it is essential: (a) that the graphical means employed represent the relations adequately and as free from distortion as possible; (b) that they are easy of application, and (c) that wherever possible the func-

tions be plotted in such a form that their changes can be represented by straight lines. Eight plates, drawn on these principles, are included, and furnish solutions for the following equations:

$$\sin i = n \sin R, \sin^2 i = n^2 \sin^2 \gamma, \frac{\gamma^1 - \alpha^1}{\gamma - \alpha} = \sin \vartheta_1 \sin \vartheta_2,$$

$$\tan^2 V_\alpha = \frac{\frac{1}{\beta^2} - \frac{1}{\gamma^2}}{\frac{1}{\alpha^2} - \frac{1}{\beta^2}}, \tan V_\alpha = \sqrt{\frac{\frac{1}{\beta^2} - \frac{1}{\gamma^2}}{\frac{1}{\alpha^2} - \frac{1}{\beta^2}}}, \cot A = \sin B \cdot \cot C, \text{ and}$$

$$\sin A = \sin B \cdot \sin C.$$

F. E. W.

PETROLOGY.—*A graphical plot for use in the microscopical determination of the plagioclase feldspars.* FRED. EUGENE WRIGHT. Am. Jour. Sci. (4), **36:** 540–542. 1913.

On this plot the changes in the optical properties of the plagioclase feldspars with chemical composition are indicated by a set of curves, the purpose being to furnish the petrologist, in convenient form and on a single sheet, all the constants essential for the accurate determination of the plagioclase feldspars in thin rock sections. A new set of curves for the extinction angles on sections showing symmetrical carlsbad-albite twinning is included, the values having been derived graphically from the best available measurements on plagioclase feldspars.

PETROLOGY.—*Oblique illumination in petrographic microscope work.* FRED EUGENE WRIGHT. Am. Jour. Sci. (4), **35:** 63–82. 1913.

The study of interference phenomena resulting from oblique illumination between crossed nicols enables the observer to determine many optical features in a given mineral plate. These phenomena are identical, so far as interference colors go, with the phenomena obtained in interference figures from the same plate in convergent polarized light. The study of mineral plates by the method of oblique illumination is of value because it impresses the mind of the observer with the interdependence of optical and crystallographic properties. It is, however, highly important that the observer realize the essential agreement between the phenomena observed in oblique illumination and those seen on interference figures in convergent polarized light. In the interference figures the interference color phenomena are seen at a glance, and if they be studied with reference to the position of the mineral

from which they are obtained, all of the conclusions to be ascertained by means of the method of oblique illumination can also be derived with even greater facility from the interference figure. For the study of interference phenomena the method of oblique illumination does not offer any special advantages over the convergent polarized light method, but it does present certain disadvantages in manipulation and in the distinctness of the phenomena observed which cannot be disregarded entirely. This is especially true if oblique illumination be obtained by use of a stop in the eye circle of the ocular as recently suggested by Schneiderhöhn.

In this paper, the phenomena produced by oblique illumination are discussed in some detail. Attention is directed to an obvious but important fact, too often disregarded in petrographic microscope work, that for the accurate measurement of extinction angles central illumination by parallel plane-polarized light is highly essential. Satisfactory measurements of extinction angles cannot be made when the section is illuminated by a strongly convergent cone of light, incident under all angles and in all azimuths, F. E. W.

GEOLOGY.—*The volcanic cycles in Sardinia.* H. S. WASHINGTON. Comptes Rendus Congrès Géologique International XII, Toronto, 1913.

The volcanoes of northwestern Sardinia were studied in the autumn of 1905. They belong to three distinct periods, with interesting lavas, which show very marked cycles, or recurrent successions of characters, in their eruptions. These lavas are now being studied, and are to be described soon, along with some forty analyses, in a series of papers.

Taking these volcanoes as a text, some broad subjects of modern petrology are discussed briefly. It is pointed out that, while no one sequence of types is generally applicable, the sequence seems to vary with the magmatic character and usually closes with basalts, tho any generalizations must be rather hazardous owing to the inherently accidental character of the rock sequences observed by us. A change in the character of the magma and in the volcanic cycles seems to be connected with a change in the mode of volcanicity, the relation being possibly a causal one, but the inadequateness of present data for such studies is pointed out. The so-called Atlantic and Pacific tribes of rocks are briefly discussed and objections raised against them, it being urged among other things that it is illogical and unjustified to select only two types for contrast to the exclusion of others equally important. In con-

clusion, the importance of further and more detailed systematic study of volcanoes, the need of numerous chemical analyses, the importance of the application of physico-chemical research to petrological problems, and the magnitude and complexity of such future investigations, are insisted on. H. S. W.

GEOLOGY.—*The general principles underlying metamorphic processes.* JOHN JOHNSTON and PAUL NIGGLI. J. Geol. **21**: 481–516. 1913.

This paper is an endeavor to set forth the most important general principles concerned in rock metamorphism—a general term which includes a number of special cases all of which, however, differ only in the degree of predominance of one (or more) of a definitely limited group of effective factors. These factors are: temperature, uniform pressure, stress (non-uniform pressure), and gross composition of the system at the time of metamorphism; the same, namely, which determine the equilibrium of the relatively simple chemical systems hitherto investigated experimentally. The knowledge gained from a study of these simple systems may be used as a basis for a prediction of the general character and significance of metamorphic processes; tho in applying the principles one must always bear in mind th se circumstances which oppose the attainment of a state of true equilibrium, such, for example, as slowness of reaction or the formation of metastable intermediate products.

Now, altho the general character of the process may be predicted, no particular statement as to the effects produced in a given system by change of any of the above factors can yet be made, owing to lack of the requisite quantitative data. In this connection, it is to be noted that the general application of experimental results which obtain for a given system under given external conditions, to another system under similar conditions, or even to the same system under widely differing conditions, is subject to considerable limitation. Conclusions drawn from such extrapolation of experimental evidence will commonly be of little value, and may be altogether misleading; moreover, one may as well guess the final result as arbitrarily choose the data required in calculating it. From this we see that the application of the above simple principles, which determine rock metamorphism, to the complicated rock systems will be no simple matter, but will require extended experimental investigation and a long time. In such investigation the first thing necessary is a definite conception of the general processes of rock metamorphism; this it was the purpose of the authors to present. The choice of par-

ticular problems in this large field will doubtless be aided greatly by a study of natural mineral associations from the physical chemical standpoint, a study which at the same time will certainly provide us with information bearing directly on the problems at issue. J. J. and P. N.

GEOLOGY.—*Geology of the Koyukuk-Chandalar region, Alaska.* A. G. MADDREN. U. S. Geological Survey Bulletin 532. Pp. 116, with maps and views. 1913.

The Koyukuk-Chandalar Region, as here described, embraces the greater part of two coextensive basins, situated north of the Arctic Circle, from which flow the Koyukuk and Chandalar Rivers, large northern tributaries of the Yukon River. Placer gold bearing gravels occur along the upper branches of several of the principal tributaries of these large rivers, and the exploitation of these deposits since 1899, with a total production of about $3,000,000, has given the region its economic importance and the distinction of being one of the northernmost gold mining districts in the world. Gold lode deposits also occur about the sources of Big Creek in the Chandalar Valley.

The general geology of these two basins is similar. The bedrock consists largely of a complex of highly metamorphosed schistose, probably pre-Cambrian or early Cambrian, sediments of mica-quartz, quartzitic, and phyllitic types. In these schists granitic intrustives of late Cretaceous or early Tertiary age occur, which are in part metamorphosed but in part also comparatively unaltered. The mineralization, that has been locally induced by some of these intrusives, appears to be largely accountable for the gold. Across the central part of the region extends a belt of more or less metamorphosed sediments, largely made up of cherts and fine-grained quartzites, considered to be of Devonian age. The northern mountainous belt of the region is largely occupied by a thick series of massive, probably Carboniferous, crystalline limestones in which are some thinner beds of semi-schistose sediments. In the southwestern part of the region the central Koyukuk Valley is occupied by Cretaceous sediments, largely marine and unmetamorphosed, but considerably folded and somewhat faulted. Only one small isolated area of Tertiary sediments is known. It is on upper Dall River and contains at least one bed of lignite. There are also some horizontal basaltic and andesitic flows in the southern part of the district which are probably of late Tertiary or early Quarternary age.

The mountainous northern half of the region has been heavily glaciated. The headwater valleys, both of the Chandalar and Koyukuk

basins, owe their present bed rock configuration to the erosion effected by long valley glacier ice streams that had their sources on the Arctic divide and flowed southward. Upon the retreat of these valley glaciers, which have now entirely disappeared from this part of the Arctic Mountains, widespread deposits of glacial outwash gravels, sands, and silts were left along the large valley. The present large streams have dissected and aggraded their flood plains but large quantities of the older gravels still remain as wide sloping terraces. In many cases the gold-bearing gravels represent old pre-glacial stream gravels. These deposits are now buried under silts and recent stream gravels and are mined by shafts and drifts. But most of the gold production has been from shallow deposits of gravel along the present streams. A. G. M.

GEOLOGY.—*Ore deposits of the Helena mining region, Montana.* ADOLPH KNOPF. Bulletin U. S. Geological Survey No. 527. Pp. 143, with maps, sections, and illustrations. 1913.

The Helena mining region is an area of 1300 square miles in southwestern Montana. The oldest rocks consist principally of sediments ranging in age from Algonkian to Cretaceous. They include mainly limestone, shale, and quartzite and lie in angular accordance from the lowermost member to the top of the series. They are conformably overlain by andesite and latite lavas and breccias of probable late Cretaceous age. These older rocks were invaded by a large granite mass which forms the northern extension of a great intrusion in southwestern Montana, known as the Boulder batholith. Large intrusions of aplite in irregular masses and dikes followed the main irruption. They are commonly tourmaliniferous, and in places, notably so. In late Miocene time, a series of dacites, consisting of lavas, tuffs and breccias, locally at least 2400 feet thick, were extravasated upon the deeply eroded surface of the granite and older rocks.

The ore deposits of the region fall into two distinct groups, widely separated in time of origin. The older are late Cretaceous or early Tertiary in age, the younger are post-Miocene. The ore bodies of the first period of mineralization are mainly argentiferous lead and gold-silver deposits. They have furnished the greater part of the production of the region; in fact, the value of their output has been roughly three times that of the post-Miocene deposits. The argentiferous lead deposits constitute the prevailing type of ore body of the older group. They are situated as a rule near the contact of the granite and the rocks invaded by it, and are replacement-fissure lodes containing galena, sphal-

erite, pyrite, and arsenopyrite. They are commonly tourmaliniferous. In certain deposits, as at Rimini, tourmaline is extremely abundant; in fact, it occurs there in the same abundance that characterizes the tin lodes of Cornwall. Three types of tourmalinic lodes with transitions between them are recognized—lead-silver, copper-silver, and gold. The predominant is the tourmalinic lead-silver, a type peculiar to the region, so far as shown by the literature of ore deposits. The ores were formed at high temperatures, and it is regarded as probable that the ore-forming solutions were a final differentiation product of the granitic magma.

The ore bodies of post-Miocene age are essentially precious-metal deposits. They are characterized by the tendency of the quartz gangue to display a cryptocrystalline development, either flinty, chalcedonic, or densely saccharoidal, resembling porcelain. Equally characteristic is the thinly lamellar calcite of the gangue and its pseudomorphic replacement by quartz, forming a type of ore common in so many of the late Tertiary gold fields of the Western States. In common with these the tenor of the ores decreases abruptly below the 500-foot level. These deposits are typically developed in the upper Miocene dacites of Lowland Creek, but their analogues at Marysville have furnished the bulk of the output. A. K.

PALAEONTOLOGY.—*Cambrian Holothurians.* AUSTIN H. CLARK. American Naturalist **47**: 488–507. August, 1913.

Among the remarkable organisms described from the Cambrian of British Columbia during the past year by Dr. Walcott were a number which he referred to the Holothuroidea, the most extraordinary of these being a pelagic animal called by him *Eldonia ludwigi*. As the correctness of the determination of these creatures as holothurians was questioned in a review by Dr. Hubert Lyman Clark, the present author was led to reply to his criticism for the reason that, as stated in Dr. Walcott's original paper, it had been he who first suggested the possibility that *Eldonia* might be a holothurian, tho he had not at the time examined the other specimens.

Dr. Walcott, Dr. Hubert Lyman Clark and the present author all made independent investigations upon the material in question, and the last mentioned was led to the following conclusions: *Eldonia* is a free-swimming holothurian, and is most closely related to the species of the family Elpidiidae. In body form alone does *Eldonia* resemble a medusa; this general resemblance may therefore be safely disregarded

as a parallelism resulting from a similar pelagic habit. In the general shape of the body as well as in the course of the digestive tube *Eldonia* approaches *Trochosphaera* (and trochophore larvae); but the enormous discrepancy in size, the broad fringe about the body, the large tentacles on either side of the mouth, the absence of muscles of the group type characteristic of the rotifiers, and the submarginal anus, seem to negative the idea that the two can be in any way related. The medusoid body form, the absence of a protrusible proboscis and the presence of a large branched tentacle on either side of the mouth appear to offer conclusive evidence that *Eldonia* cannot be a worm. The digestive tube of *Eldonia* resembles that of the heteroradiate echinoderms, and especially that of certain holothurians; the tentacles on either side of the mouth suggest an affinity with the holothurians; the radial canals leading to a central ring are comparable to the radial canals and the central ring of the holothurians; the broad circular muscle about the body suggests a modified longitudinal holothurian muscle, and is of the group type characteristic of the echinoderms; the broad brim about the body is strikingly similar to the brim developed in certain elpidiid holothurians, such as *Euphronides tanneri* and *Scytoplanes typicus*. A pelagic holothurian is known as an inhabitant of the recent seas; tho very different in origin and in affinities from *Eldonia* it demonstrates that a pelagic habit is not impossible in the group. The species of the family Elpidiidae are preëminently inhabitants of the deep sea; this suggests that the fossil representatives of the family should be found in very early geological formations. Therefore *Eldonia* is a pelagic holothurian, related to the species of the family Elpidiidae.

No marine animals are known outside of the holothurian family Elpidiidae which have a body form like that of *Louisella pedunculata* in all its details; but this species agrees in every particular with one or other of the species in that family. We cannot, therefore, escape the conclusion that *Louisella pedunculata* should find a place in the family Elpidiidae along with all the recent animals which in any way resemble it.

By exactly the same reasoning *Laggania cambria* is assigned to a position in the same group.

The type specimen of *Mackenzia costalis* shows a pleated structure which can only be interpreted as due to longitudinal mesenteries, probably eight in number; there appear to have been sixteen processes around the mouth which probably indicate tentacles retracted before preservation; the distal portion of the body resembles closely the distal

portion of the body in the genus *Edwardsia*. Thus, as *Mackenzia costalis* presents characters not found outside of the Zoantharia, and in that group peculiar to the family Edwardsiidae, it seems necessary to assign it to a position in the family Edwardsiidae, near the genus *Edwardsia*.

In brief the disposition of these fossils is as follows:

Holothuroidea
- Family Elpidiidae
  - Genus *Laggania*
  - Genus *Louisella*
- Family Eldoniidae (near the Elpidiidae)
  - Genus *Eldonia*

Zoantharia
- Family Edwardsiidae
  - Genus *Mackenzia*.

A. H. C.

BOTANY.—*Feroniella, genre nouveau de la tribu des* Citreae, *fondé sur le* F. oblata, *espèce nouvelle de l'Indo-Chine*. WALTER T. SWINGLE. Bull. de la Soc. bot. de France, **59**: 774–783. Fig A, Pl. 18. No. 8, séances novembre-décembre, 1912. Pub. Feb. 18, 1913.

To the eight known species of hard-shelled citrous fruits, comprising four genera, is added a ninth species, *Feroniella oblata*, from Cochinchina, the type of a new genus Feroniella. This genus resembles Feronia in having pinnate leaves, large flowers and one-celled fruits due to the fusing of the 5 to 6 ovary cells, and differs from it in having twice the number of stamens (four times as many as the number of petals), filaments with hairy basal appendages, smooth seeds, and the epicarp composed of radially disposed prismatic elements. Appendices to the filaments are not known in any other plant hitherto studied of the tribe *Citreae*. The hairs of the appendices become entangled and form a sort of cup, protecting the base of the ovary from insects too small to effect pollination. The structure of the epicarp of the fruit also differs in its radially disposed woody structure from that of the other genera of this tribe.

The type of the genus, *Feroniella oblata*, takes its specific name from the shape of the fruit which is a flattened spheroid like a mandarin orange. A cross section of the fruit is figured and an excellent plate shows a twig with leaves and flowers, giving the flower structure in detail. This tree, which attains a height of 8 to 20 meters, is found

thruout Cambodia and also occurs in Cochinchina, central Laos and eastern Siam.

Feronia lucida Scheff. is transferred to this genus, becoming *Feroniella lucida* (Scheff.) Swingle. MAUDE KELLERMAN.

ZOOLOGY.—*Revision of the crinoid genus Himerometra.* AUSTIN HOBART CLARK. Proceedings of the U. S. National Museum, **46**: 279–289. 1913.

This paper includes a history of the genus, a list of all the references to the included species, correctly identified, a key to the species, a list of the six species with the synonymy, range and depth of each, and a discussion of the phylogenetical interrelationships within the group.

This genus differs from the more closely related genera in having the proximal or lower pinnules very much enlarged, with the first the longest and the following decreasing in size. There are three specific groups within the genus of two species each, distinguished by different stages in the specialization of the lower pinnules. In the first, least specialized, group these pinnules are scarcely stouter than in the allied genera, but they are long and flagellate, the first being the longest. This group ranges from the East Indies to the Persian Gulf. In the second group the lower pinnules are very stout, but they possess a flagellate tip. This group ranges from the East Indies to the Maldive Islands. In the third, most specialized, group the lower pinnules are extremely stout, and end abruptly without a flagellate tip. This group occurs from the Moluccas and the Philippine Islands to the Mergui Archipelago. In all of the three groups the more specialized of the two species occurs in the Malay Archipelago. A. H. C.

TECHNOLOGY.—*The metric carat.* Bureau of Standards Circular No. 43.

After July 1, 1913, the metric carat of 200 mgms. is recognized as the standard of weight for diamonds and other precious stones and this standard will be used in the certification of all carat weights submitted to the Bureau after that date. The Treasury Department also adopted this standard on the same date for use in the customs service in levying the duties on gems. The change from the former uncertain and indefinite carat weight, usually equal to about 205.3 mgms., to the definite and impler metric carat was facilitated in the United States by the joint action of all the large dealers in diamonds, pearls and other precious stones, who, realizing the chaotic condition due to the various

weights used as a carat, after recommendation by the International Bureau of Weights and Measures and the Bureau of Standards decided upon the metric carat as the solution of the difficulty and decided to put its use into effect on the same date. Until recently nearly every civilized country of the world has used a different standard of weight for diamonds. Many of the nations, however, have lately adopted the one unit of a carat of 200 mgms., and Spain, Italy, Bulgaria, Denmark, Norway, Japan, Portugal, Roumaia, Switzerland, Sweden, France, Germany, Holland and Belgium are in the list with the United States of those countries which now have the new international standard. In England the change has not yet been adopted.

The circular gives complete tables by which weights in the old carats can be determined in terms of the new unit and vice versa, and also calls attention to the need of more accurate weighing of precious stones because of their great value and especially of greater care of the balances and weights used for the purpose. R. Y. FERNER.

REFERENCES

HYDROLOGY.—*Surface water supply of the United States, 1910. Part XII.—North Pacific Coast.* F. F. HENSHAW, E. C. LA RUE, and G. C. STEVENS: U. S. Geological Survey, Water Supply Paper 292. Pp. 685. 1913.

Gazetteer of surface waters of California. Part III.—Pacific Coast and Great Basin streams. B. D. WOOD: U. S. Geological Survey Water Supply Paper 297. Pp. 244. Prepared in coöperation with State Water Commn. and Conservation Commn. of State of California.

Water Resources of California. Part III.—Stream measurements in the Great Basin and Pacific Coast River Basins. H. D. MCGLASHAN and H. J. DEAN. Prepared in coöperation with State Water Commn. and Conservation Commn. of State of California. U. S. Geological Survey Water-Supply Paper 300. Pp. 956. 1913.

Surface water supply of the United States. 1911. Part X.—The Great Basin. F. F. HENSHAW, H. D. MCGLASHAN, and E. A. PORTER. U. S. Geological Survey, Water-Supply Paper 310. Pp. 210, maps and sections. 1913.

Water powers of the Cascade Range. Part II.—Cowlitz, Nisqually, Puyallup, White, Green, and Cedar drainage basins. F. F. HENSHAW and GLENN L. PARKER. Prepared in coöperation with Washington State Board of Geological Survey. U. S. Geological Survey Water-Supply paper 313. Pp. 170, maps and sections. 1913.

TECHNOLOGY.—*Recent papers of the Bureau of Standards:*

The density and thermal expansion of linseed oil and turpentine. H. W. BEARCE. Pp. 27. 1912.

The melting points of fire bricks. C. W. KANOLT. Pp. 17. 1912.

Comparison of five methods used to measure hardness. RALPH P. DEVRIES. Pp. 27. 1912.

Action of the salts in alkali water and sea water on cements. P. H. BATES, A. J. PHILIPS, AND RUDOLPH J. WIG. Pp. 157. 1912.

The evaporation test for mineral lubricating and transformer oils. C. E. WATERS. Pp. 13. 1913.

Legal specifications for illuminating gas. E. B. ROSA and R. S. MCBRIDE. Pp. 31. 1913.

Surface insulation of pipes. BURTON MCCOLLUM and O. S. PETERS. 1913.

The manufacture of lime. W. E. EMLEY. Pp. 130. 1913.

The function of time in the vitrification of clays. G. H. BROWN and G. A. MURRAY. Pp. 26. 1913.

Electrolysis in concrete. E. B. ROSA, BURTON MCCULLOM, and O. S. PETERS. 1913.

Physical testing of cotton yarns. W. S. LEWIS. Pp. 31. 1913.

Determination of sulfur in illuminating gas. R. S. MCBRIDE and E. R. WEAVER. Pp. 46. 1913.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 726th meeting was held on May 24, 1913, at the Cosmos Club, Vice-President Bowie in the chair; 33 persons present.

Mr. C. G. ABBOT presented a paper on *Results of measurements of solar radiation.* The essential features of this paper are presented in the article on *The variations of the sun* by ABBOT, TOWLE and ALDRICH published in this Journal, **3**: 309-315. 1913. Messrs. HUMPHREYS, PAUL and HERSEY discussed the paper.

Mr. A. W. GRAY then spoke on *The control of temperature in an electric furnace.* After a brief review of previous experiments to secure uniformity of temperature in an electrically heated air column by using the central portion of a sufficiently long tube and by crowding the windings near places where heat was lost most rapidly, the speaker described a development of the electric furnace. The independently heated end plugs of the earlier pattern were retained; two concentric cylindrical heaters of nichrome ribbon, wound longitudinally and separated by air and asbestos, supplied heat uniformly for entire length of the interior. The new winding distributes any irregularities in resistance in such a way as not to affect the longitudinal distribution of temperature, is non-inductive, limits difference of potential between adjacent windings to drop occurring in a length of ribbon twice as long as furnace, limits to this length the amount of ribbon that can be accidentally short-circuited, and brings out both terminals of a heater at same end of furnace and diametrically opposite. Lantern slides were presented showing results under various conditions. A further improvement consisted in moving heating coils of plugs to extreme ends of furnace, making it easy to secure uniformity of temperature within a few tenths of a degree over at least twice the length of the furnace. The paper was discussed by Mr. White as to point of highest temperature and mechanical details. At 10.00 p.m. the meeting adjourned.

The 727th meeting was held on October 11, 1913, at the Cosmos Club, Vice-President Bowie in the chair; 41 persons present.

Mr. L. J. BRIGGS presented a paper giving the results of an investigation by himself and Mr. H. L. SHANTZ on *The water requirements of plants.* The governing conditions determining the absorption of water by the roots of plants, its translocation thru the stems, and its final evaporation from the leaves were first discussed. Attention was directed to peculiar structural modifications found in certain plants, which are apparently

for the purpose of reducing the loss of water. In view of these changes, wide variations as regards efficiency in use of water by different plants might be expected. The authors found this to be the case. The amount of water transferred is very great compared with the dry matter produced. In the experiments direct evaporation from the soil was prevented by the use of perforated covers, the openings about the stems of the plants being sealed with wax. Six pots were used for each variety, to provide a basis for calculating the probable errors of the water requirement ratios. The water requirement is profoundly modified by differences in climatic environment. The average for 25 varieties grown at Akron, Colorado, in 1912 was only 79 ± 2 per cent of that of the same varieties in 1911, while the evaporation in 1912 was 78 ± 2 per cent of that in 1911. Paper was illustrated by photographs and lantern slides. Upon request of the chair, Mr. SHANTZ made some additional remarks concerning the investigation. Botanists were interested in this question as early as 1699. The paper was discussed by Messrs. BOWIE, CURTIS, COBLENTZ, HUMPHREYS, and WENNER.

Mr. M. D. HERSEY then gave a brief review of the *Birmingham meeting of the British Association*. In the Engineering Section great interest was shown in the discussion of complex stress distribution and failures and in report on electrical units and nomenclature. In the Physical and Mathematical Section the papers dealt chiefly with modern theories of radiation. Reference was made to the Presidential and Vice-Presidential addresses and the relatively greater importance attached to the social and general features than with the American Association.

Upon the suggestion of Mr. Hersey, the chair invited Mr. W. F. G. SWANN to give informally brief abstracts of his papers before the Birmingham meeting on *The electrical resistance of thin metallic films* and on *The expression for the electrical conductivity of a metal*. The first give a theory to explain the abnormally high apparent specific resistance of a very thin film, while the second called attention to the fact that Drude's expression requires a correction in coefficient in denominator from 4 to 3. At 10 p.m. the meeting adjourned.

The 728th meeting was held on October 25, 1913, at the Cosmos Club, Vice-President Bowie in the chair; 30 persons present.

Mr. J. H. DELLINGER presented a paper on *The measurement of high frequency currents*. Three effects made use of in such measurements are electro-dynamic, electro-static, and thermal. The last is most successfully and generally used and four methods involving this effect were discussed. The different appliances, experimental apparatus, and standard instruments were briefly described. The theoretical considerations and formulae were discussed. The conclusions drawn were that circuit of ammeter must be simple, the straight wire type of instrument is superior, and that errors may be eliminated by use of high resistance. The paper was discussed by Messrs. OLSHAUSEN and ROSA.

Mr. F. W. WELLS then presented by invitation a paper entitled

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 726th meeting was held on May 24, 1913, at the Cosmos Club, Vice-President Bowie in the chair; 33 persons present.

Mr. C. G. ABBOT presented a paper on *Results of measurements of solar radiation*. The essential features of this paper are presented in the article on *The variations of the sun* by ABBOT, TOWLE and ALDRICH published in this Journal, **3**: 309-315. 1913. Messrs. HUMPHREYS, PAUL and HERSEY discussed the paper.

Mr. A. W. GRAY then spoke on *The control of temperature in an electric furnace*. After a brief review of previous experiments to secure uniformity of temperature in an electrically heated air column by using the central portion of a sufficiently long tube and by crowding the windings near places where heat was lost most rapidly, the speaker described a development of the electric furnace. The independently heated end plugs of the earlier pattern were retained; two concentric cylindrical heaters of nichrome ribbon, wound longitudinally and separated by air and asbestos, supplied heat uniformly for entire length of the interior. The new winding distributes any irregularities in resistance in such a way as not to affect the longitudinal distribution of temperature, is non-inductive, limits difference of potential between adjacent windings to drop occurring in a length of ribbon twice as long as furnace, limits to this length the amount of ribbon that can be accidentally short-circuited, and brings out both terminals of a heater at same end of furnace and diametrically opposite. Lantern slides were presented showing results under various conditions. A further improvement consisted in moving heating coils of plugs to extreme ends of furnace, making it easy to secure uniformity of temperature within a few tenths of a degree over at least twice the length of the furnace. The paper was discussed by Mr. White as to point of highest temperature and mechanical details. At 10.00 p.m. the meeting adjourned.

The 727th meeting was held on October 11, 1913, at the Cosmos Club, Vice-President Bowie in the chair; 41 persons present.

Mr. L. J. BRIGGS presented a paper giving the results of an investigation by himself and Mr. H. L. SHANTZ on *The water requirements of plants*. The governing conditions determining the absorption of water by the roots of plants, its translocation thru the stems, and its final evaporation from the leaves were first discussed. Attention was directed to peculiar structural modifications found in certain plants, which are apparently

for the purpose of reducing the loss of water. In view of these changes, wide variations as regards efficiency in use of water by different plants might be expected. The authors found this to be the case. The amount of water transferred is very great compared with the dry matter produced. In the experiments direct evaporation from the soil was prevented by the use of perforated covers, the openings about the stems of the plants being sealed with wax. Six pots were used for each variety, to provide a basis for calculating the probable errors of the water requirement ratios. The water requirement is profoundly modified by differences in climatic environment. The average for 25 varieties grown at Akron, Colorado, in 1912 was only 79 ± 2 per cent of that of the same varieties in 1911, while the evaporation in 1912 was 78 ± 2 per cent of that in 1911. Paper was illustrated by photographs and lantern slides. Upon request of the chair, Mr. SHANTZ made some additional remarks concerning the investigation. Botanists were interested in this question as early as 1699. The paper was discussed by Messrs. BOWIE, CURTIS, COBLENTZ, HUMPHREYS, and WENNER.

Mr. M. D. HERSEY then gave a brief review of the *Birmingham meeting of the British Association*. In the Engineering Section great interest was shown in the discussion of complex stress distribution and failures and in report on electrical units and nomenclature. In the Physical and Mathematical Section the papers dealt chiefly with modern theories of radiation. Reference was made to the Presidential and Vice-Presidential addresses and the relatively greater importance attached to the social and general features than with the American Association.

Upon the suggestion of Mr. Hersey, the chair invited Mr. W. F. G. SWANN to give informally brief abstracts of his papers before the Birmingham meeting on *The electrical resistance of thin metallic films* and on *The expression for the electrical conductivity of a metal*. The first give a theory to explain the abnormally high apparent specific resistance of a very thin film, while the second called attention to the fact that Drude's expression requires a correction in coefficient in denominator from 4 to 3. At 10 p.m. the meeting adjourned.

The 728th meeting was held on October 25, 1913, at the Cosmos Club, Vice-President Bowie in the chair; 30 persons present.

Mr. J. H. DELLINGER presented a paper on *The measurement of high frequency currents*. Three effects made use of in such measurements are electro-dynamic, electro-static, and thermal. The last is most successfully and generally used and four methods involving this effect were discussed. The different appliances, experimental apparatus, and standard instruments were briefly described. The theoretical considerations and formulae were discussed. The conclusions drawn were that circuit of ammeter must be simple, the straight wire type of instrument is superior, and that errors may be eliminated by use of high resistance. The paper was discussed by Messrs. OLSHAUSEN and ROSA.

Mr. F. W. WELLS then presented by invitation a paper entitled

Interpreting irregular data. The manifestations of nature are of utmost irregularity; of all sciences, that of agriculture is richest in data but poorest in correlation. The most generally used method for discussion is that of averages, but in biological and other fields this method is of little value. The author has been quite successful in the application of the integral of the probability curve to data of this character. Lantern slides were shown to illustrate such application to data for turbidity of Washington water before and after operation of filtration plant, and to data showing number of leucocytes in morning and evening milk. The paper was discussed by Messrs. HERSEY and SWANN.

Upon invitation of the chair, Mr. C. E. ST. JOHN, of the Mt. Wilson Solar Observatory, gave an informal report upon the social and scientific features of the recent conference of the Solar Union at Bonn. He abstracted briefly each day's proceedings. Reports were given by various committees on solar radiation; standard wave lengths; solar atmosphere; solar rotation, sun-spots and eclipses, and magnetic state of the Sun. The speaker referred particularly to the favorable reception accorded the work of Abbott and to the fact that the American contingent of workers is bearing its fair share in the development of solar research. The chair expressed the thanks of the Society to Mr. St. John for the report. At 10.00 p.m. the meeting adjourned.

J. A. FLEMING, *Secretary*

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 270th meeting of the Society was held in the Cosmos Club on April 23, 1913.

An informal communication was presented by B. S. BUTLER on *Basic ferric sulfates in Utah.*

REGULAR PROGRAM

A remarkable skeleton of Stegosaurus (illustrated): C. W. GILMORE. The type specimen of *Stegosaurus stenops* recently prepared and placed on exhibition in the U. S. National Museum constitutes the most perfect skeleton of this remarkable dinosaur ever found. It is also unique in being the first specimen to give positive evidence as to the position and arrangement of the large dermal plates with which, in life, its back was adorned. The position of the various parts of the skeleton, as explaining the manner of death, and entombment of this particular specimen were discussed.

The facts relating to the dermal armor which now appear to be established from this preliminary study are: (1) That the armor of the neck, back, and tail was formed by two rows of erect plates, the elements of one row alternating with those of the other; (2) that the total number of plates in the two rows was not less than 20 and not more than 22; (3) that the position of the largest plate of the series appears to be above the base of the tail and not over the pelvis; (4) that the usual number of dermal spines on the tail is four arranged in two pairs.

A microscopic study of sulfide ores of copper (illustrated): L. C. GRATON. This paper is presented in full in the *Bi-monthly Bulletin of the American Institute of Mining Engineers.* 1913.

The 271st meeting of the Society was held in the Cosmos Club on May 14, 1913.

Reconnaissance of the Lower Fraser River, B. C.: N. L. BOWEN. The speaker examined the region bordering on the Fraser River from Lytton to Vancouver, British Columbia, during the summer of 1912, for the Geological Survey of Canada. The section crosses the Coast-Cascade uplift. The oldest rocks are highly disturbed argillites and quartzites with thin beds of limestone and associated volcanic rocks which are correlated on lithologic grounds with the Cache Creek group of Pennsylvanian age. With these are infolded a series of banded gray argillites which have yielded a single Mesozoic fossil and which are considered probably Jurassic. These latter have formerly been described by G. M. Dawson under the name Boston Bar group and tho he considered them probably Palaeozoic, the name is retained. Both of these earlier series strike, as a rule, northwestward and commonly have high dips. They have been invaded by Upper Jurassic granites which are generally somewhat sheared and in places have become typical gneiss. On the western flank of the Coast Range, near Agassiz and Chilliwack, occurs a sedimentary series which is probably also Jurassic, tho much less metamorphosed than its supposed eastern equivalent (Boston Bar group). The beds have yielded only indefinite Mesozoic fossils. The chief rock types are conglomerate, argillite, usually black, and limestone with a possible basal member of quartz porphyry. The strikes are northeastward, a rather unusual strike in the Cordillera.

Lower Cretaceous rocks, characterized by a moderate degree of disturbance, occupy a down-faulted belt running roughly parallel to the valleys of Fraser and Anderson rivers. The structure within the belt is synclinal. The rocks are dominantly clastic; arkose, argillite, and conglomerate making up the group, locally termed the Jackass Mountain group. Later batholithic rocks, provably Upper Cretaceous, occupy a wide belt near Hope and Agassiz. They differ from the Jurassic granites in being fresh and unsheared, and the dominant types are granodiorite, quartz diorite, and diorite with a later alkaline granite probably separated from the other types by a considerable time interval. The Jurassic and the Cretaceous batholiths make up the Coast Batholith. The Eocene beds of the Puget group occurring in the lower courses of the Fraser are clearly younger than all the rocks heretofore mentioned including the later batholiths. They are slightly disturbed and consist, on the whole, of little indurated beds of sandstone, conglomerate, and shale, presumably of estuarine character. The whole region with the exception of the higher peaks was covered with the Cordilleran ice sheet.

Some special features of the glaciation of the Catskill Mountains: H. E. MERWIN. Many of the rounded peaks of the Catskills reach heights

of nearly 4000 feet above the sea and above the Hudson-Mohawk lowland east and north. Glacial striae have been found on the tops of some of these peaks, but the peak farthest south, Slide Mountain, altitude 4200, is covered with loose residual gravel. The Catskills are unique in having several long deep valleys trending across the path of the main ice movement. These head in the bold escarpment above the Hudson valley, and drain westward. From their heads passes open about 2000 feet above the Hudson valley. During the period of ice retreat tongues of ice from the lobe in the Hudson valley flowed thru the passes down the valleys producing deposits which simulate accumulations from local glaciers. In hollows between spurs on the north sides of some of the peaks masses of ice entering from the north seem to have been cut off. Against these stagnant masses, yearly advances of the main ice tongues made deposits which are now barriers between the spurs.

The present attitude of German geographers toward W. M. Davis' explanatory description of land forms: FRANÇOIS E. MATTHES. (No abstract.)

RALPH W. RICHARDS, *Secretary.*

ANNOUNCEMENT OF MEETINGS

CHEMICAL SOCIETY OF WASHINGTON

(Local Section American Chemical Society)

The 233d meeting will be a special meeting, to be held at the Cosmos Club at 8.15 p. m., Monday, December 22. Professor EARL B. PHELPS, of the Hygienic Laboratory will lecture on "Recent Advances in Sewage Chemistry."

ROBERT B. SOSMAN, *Secretary.*

ERRATA

Page 39, table, columns 1 and 2, for "camphor" read "thymol"; for "thymol" read "camphor"; column 4, for "23" read "77"; column 5 omit "77" and the last "100"; column 6, below "50" insert "23" and "100".

Page 249, second line from top read
"F. H. TUCKER" instead of "F. H. TUTTLE."

INDEX TO VOLUME III

PROCEEDINGS, PROGRAMS AND ANNOUNCEMENTS OF THE ACADEMY AND AFFILIATED SOCIETIES

Anthropological Society of Washington. Proceedings: 31, 91, 128, 155, 200, 304, 479, 510.

Biological Society of Washington. Proceedings: 174, 267, 427, 509.

Botanical Society of Washington. Proceedings: 92, 132, 264, 279, 596.

——Programs and announcements: 52.

Chemical Society. Proceedings: 129, 197, 260, 340, 505.

——Announcement: 540.

Congress of Americanists, Nineteenth International: 512.

Geological Society of Washington. Proceedings: 50, 156, 173, 199, 237, 300, 343, 538.

National Academy of Sciences. Semicentenary anniversary: 240.

Philosophical Society of Washington. Proceedings: 46, 296, 426, 536.

Washington Academy of Sciences. Proceedings: 121, 154, 197, 339, 505.

——Programs and Announcements: 52, 512.

AUTHOR INDEX

ABBOT, C. G. *Report on the astrophysical observatory, Smithsonian Institution, for year ending June 30, 1912. 110.

——The variation of the sun. 309.

ADAMS, L. H. *On the density of solid substances, with especial reference to permanent changes produced by high pressures. 113.

——*On the effect of high pressures on the physical and chemical behavior of solid substances. 165.

——A useful type of formula for the interpolation and representation of experimental results. 469.

ALBRIGHT, A. R. *Hydrogeneration with colloidal palladium as catalyzer. 263.

ALDRICH, L. B. The variation of the sun. 309.

ALLEN, E. T. *The sulfides of zinc, cadmium, and mercury; their crystalline forms and genetic conditions. 114.

ANDERSON, JOHN F. *Further attempts to transmit poliomyelitis thru the agency of the stable fly. 337.

ASHE, W. W. A new shrubby buckeye. 424.

AUSTIN, L. W. A comparison of arc and spark sending apparatus for radiotelegraphy. 284.

——A crystal contact disturbance preventer for radiotelegraphic receiving. 386.

——Difference in strength of day and night signals in radiotelegraphy. 326.

* Abstracts.

——Further comparison of arc and spark radio transmission. 517.
——The high frequency resistances of inductances. 94.
——The measurement of received radiotelegraphic signals. 133.
——*Recent experiments in radiotelegraphy. 299.
AYERS, S. HENRY. The destruction of bacteria in milk by ultra-violet rays. 160.
BABCOCK, WM. H. *The Islands of Antillia. 31.
BALDWIN, A. L. *The California-Washington arc of primary triangulation. 402.
BARTLETT, H. H. *Absorption and excretion of salts by roots, as influenced by concentration and composition of culture solutions. I. Concentration relations of dilute solutions of calcium and magnesium nitrate to pea roots. 26.
——*Problem of the identity of Oenothera Lamarckiana. 175.
BASTIN, E. S. *Secondary enrichment in silver. 52.
BAUER, L. A. A consistent theory of the origin of the Earth's magnetic field. 1.
——Preliminary results of a first analysis of the sun's general magnetic field. 513.
——*Researches of the Department of Terrestrial Magnetism; land magnetic observations, 1905–1910. 20.
BEATTIE, J. H. *City street sweepings as a fertilizer. 254.
——*Effect of asparagin on absorption and growth in wheat. 255.
BELZ, J. O. Evaporation in the great plains and inter-mountain districts as influenced by the haze of 1912. 381.
BINGHAM, EUGENE C. *Fluidity and its relation to other physical and chemical properties. 341.
BOUGHTON, E. W. *The effect of certain pigments on linseed oil with a note on manganese content of raw linseed oil. 257.
BOUTWELL, JOHN MASON. *Geology and ore deposits of the Park City district, Utah. 445.
BOWEN, N. L. *The binary system: $Na_2Al_2Si_2O_8$ (nephelite, carnegieite) -$CaAl_2Si_2O_8$ (anorthite). 90.
——*The melting phenomena of the plagioclase feldspars. 523.
——*Reconnaissance of the lower Fraser River, B. C. 539.
BOWIE, WM. *Determination of time, longitude, latitude and azimuth. 402.
——*Precise level net of the U. S. 298.
BREZEALE, J. F. *Effect of lime upon the alkali tolerance of wheat seedlings. 197.
BRIGGS, LYMAN J. *Application of the microscope to physical problems. 48.
——Evaporation in the great plains and inter-mountain districts as influenced by the haze of 1912. 381.
——A mechanical differential telethermograph and some of its applications. 33.
——*The water requirements of plants. 536.
BROOKS, ALFRED H. *Works of the Alaska Railroad Commission. 300.
BRYCE, JAMES. *Physical aspects of Australia and New Zealand. 297, 339.
BUNZEL, H. H. *A biochemical study of the curly-top of sugar beet. 251.
BUREAU OF STANDARDS. *Metallographic testing. Circular No. 42, 1913. 251.
——*The testing and properties of textile materials. Circular 41, 1913. 166.

* Abstracts.

BURGESS, GEORGE K. Melting points of the refractory elements. I. Elements of atomic weight from 48 to 59. 371.
——A micropyrometer. 7.
——Preliminary note on the critical ranges, A3 and A2, of pure iron. 329.
——*Present status of the temperature scale. 21.
BURLING, LANCASTER D. *Habitat of the Cambrian brachiopoda. 199.
CAIN, J. R. The determination of phosphorus in steels containing vanadium. 249.
CAPPS, S. R. *The Yentna District, Alaska. 466.
CLARK, AUSTIN HOBART. *Cambrian Holothurians. 530.
——*Crinoidea (supplement). 294.
——The systematic position of the crinoid family Plicatocrinidae. 494.
——*A revision of the crinoid family Mariametridae. 504.
——*The crinoids of the Indian Ocean. 169.
——*The crinoids of the Museum für Naturkunde, Berlin. 171.
——*The crinoids of the Natural History Museum at Hamburg. 171.
——*The crinoids of the Solomon Islands. 171.
——*Description of a collection of unstalked crinoids made by Captain Suenson in Eastern Asia. 468.
——*Descriptions of eleven new crinoids belonging to the families Calometridae and Thalassometridae discovered by the Siboga in the Dutch East Indies. 168.
——*Descriptions of twenty new recent unstalked crinoids, belonging to the families Antedonidae and Atelecrinidae, from the Dutch East Indies. 456.
——*The distribution of animals and its bearing on the peopling of America. 196.
——*Die Fauna Sudwest-Australiens: Crinoidea. 169.
——*An ingenious method of causing death employed by the Obeah men of the West Indies. 196.
——*Naumachocrinus, a new genus belonging to the crinoid family Phrynocrinidae. 168.
——*Notes on American species of Peripatus. 170.
——*Notes sur les crinoides actuels du muséum d'histoire naturelle de Paris. 169.
——*On a collection of recent Crinoids from the waters about Ireland. 336.
——*On a small collection of recent crinoids from the Indian Ocean. 170.
——*Piccole note su degli Onychophora. 456.
——*Preliminary description of eleven new crinoids belonging to the families Himerometridae, Mariametridae and Colobometridae discovered by the Siboga in the Dutch East Indies. 170.
——*The recent crinoids of Australia. 169.
——*Das relative Alter der rezenter Seelilienfaunen. 171.
——*Restoration of the genus Eldonia, a genus of free swimming Holothurians from the middle Cambrian. 167.
——*A revision of the American species of Preipatus, with a list of known forms. 170.
——*Revision of the crinoid genus Himerometra. 533.
——*Seventeen new East Indian crinoids belonging to the families Comasteridae and Zygometridae. 168.

* Abstracts.

——*Six new East Indian crinoids belonging to the family Charitometridae. 168.
——*A study of biological paleogeography in its bearing on the origin of man in America. 167.
——*A study of the salinity of the surface water in the North Pacific Ocean and in the adjacent enclosed seas. 165.
——*Three interesting butterflies from eastern Massachusetts. 404.
COBB, N. A. Draconema: A remarkable genus of marine free-living nematodes. 145.
——New nematode genera found inhabiting fresh water and nonbrackish soils. 432.
——Notes on Mononchus and Tylenchulus. 287.
COBLENTZ, WM. W. The constants of spectral radiation of a uniformly heated enclosure. 177.
——The constants of spectral radiation of a uniformly heated enclosure or so-called black body. 10.
——Summary of tests made on bismuth thermopiles. 357.
COOK, F. C. *Comparison of plant, meat, and yeast extracts. 131.
COOK, O. F. *Heredity and cotton breeding. 152.
——Ivory palms in Panama. 138.
——A new generic name for the sapote. 158.
——Web-spinning fly larvae in Guatemalan caves. 190.
CORBETT, L. C. *Lawn soils and lawns. 254.
COVILLE, FREDERICK V. The formation of leafmold. 77.
CRENSHAW, J. L. *The sulfides of zinc, cadmium, and mercury, their crystalline forms and genetic conditions. 114.
CROWE, J. J. Observations on ocean temperatures in the vicinity of icebergs and in other parts of the ocean. 405.
——Preliminary note on the critical ranges, A3 and A2, of pure iron. 329.
CURTIS, H. L. *Some properties of electric condensers. 296.
CUSHMAN, A. S. *Electrolytic determination of tin in canned food products. 131.
DALE, T. N. *The commercial marbles of western Vermont. 152.
DARTON, N. H. *Construction of a structure map of the northern anthracite field. 199.
DAY, ARTHUR L. Water and the magmatic gases. 457.
——*Are quantitative physico-chemical studies of rocks practicable? 502.
——*Densities at high temperatures. 521.
——*La mesure des températures élevées par le thermomètre a gaz. 501.
DELLINGER, J. H. High-frequency ammeters. 412.
DICKINSON, H. C. *Latent heat of fusion of ice. 453.
——*New calorimetric resistance thermometers. 296.
——Observations on ocean temperatures in the vicinity of icebergs and other parts of the ocean. 405.
DOLE, R. B. *Concentration of mineral waters in relation to their therapeutic activity. 130.
DORSEY, N. E. *The earth inductor as an inclinometer. 49.
DURAND, E. DANA. *Race statistics of the last census. 91.
EAKIN, H. M. *Geologic reconnaissance of a part of the Rampart Quadrangle, Alaska. 467.

* Abstracts.

——*Quaterary problems of central Alaska. 301.
EMMONS, W. H. *The enrichment of sulfide ores. 454.
EVERMAN, BARTON W. *Alaska fisheries and fur industries in 1911. 172.
FARIS, R. L. *A new type of compass declinometer. 112.
FASSIG, OLIVER L. *Hurricanes of the West Indies. 333.
FENNER, CLARENCE N. *Petrographic study of the specimens of loess, tierra cocida, and scoria collected by the Hrdlicka-Willis Expedition. 115.
——*Study of a contact metamorphic ore-deposit. The Dolores mine, at Matehuala, S. L. P., Mexico. 116.
FISCHER, L. A. *Some types of false weights and measures found in the U. S. 46.
FOOTE, PAUL D. *Note on the calibration of optical pyrometers. 151.
FOWLE, F. E. *The determination of aqueous vapor above Mount Wilson. 425.
——The variation of the sun. 309.
FRANKLIN, EDWARD C. *The action of potassium amide on cupric nitrate in liquid ammonia solution. 334.
——*The action of potassium amide on thallium nitrate in liquid ammonia solutions. 335.
——*Ammonia, with experiments. 339.
——*Potassium ammonotitanate. 335.
FULLER, H. C. *Determination of caffein in tea and coffee. 342.
GARREY, G. H. *Study of a contact metamorphic ore-deposit. The Dolores mine, at Matehuala, S. L. P., Mexico. 116.
GILBERT, C. C. *Ores of the Mount Lyell copper district of Tasmania. 344.
GILMORE, C. W. *A remarkable skeleton of Stegosaurus. 538.
GORE, H. C. *Biochemistry of the banana. 342.
——*Estimation of tartaric and malic acids by the use of uranium acetate and ammonium molybdate. 198.
GORE, J. H. *Siamese life and industries. 307.
GRAY, A. W. *The control of temperature in an electric furnace. 536.
GRIFFITHS, DAVID. *Effect of the recent freeze in California. 379.
GROVER, F. W. *The analysis of alternating current waves by the method of Fourier, with special reference to methods of facilitating the computations. 501.
GULBRANDSEN, SVERRE. *Incandescent gas lighting. 340.
HARPER, D. R. *Latent heat of fusion of ice. 453.
HEDGCOCK, G. G. *Notes on diseases of trees caused by Mistletoes. 265.
HEDGES, FLORENCE. *A knot of citrus trees caused by Sphaeropsis tumefaciens. 29.
HELLER, EDMUND. *Distribution of game animals in Africa. 428.
HERSEY, M. D. *A mechanical model of the least square adjustment. 296.
HESS, FRANK L. Triplite from eastern Nevada. 286.
HEWETT, D. F. *Occurrence of petroleum near Cody, Wyo. 51.
HICKS, W. B. *A short practical method for the estimation of potassium. 342.
HILL, J. N. *Zinc-lead deposits of the Yellow Pine district, Nev. 238.
HILLEBRAND, W. F. Calcium vanadates from Peru, Colorado and Utah. 157.
——A danger to be guarded against in making mineral separations by means of heavy solutions. 137.

* Abstracts.

——Two varieties of calciovolborthite (?) from eastern Utah. 138.
——*Two varieties of calciovolborthite (?) from eastern Utah. 503.
HINE, THOMAS B. *Potassium ammonotitanate. 335.
HITCHCOCK, A. S. *Notes on the botany of Trinidad. 266.
HOLMES, W. H. *Agricultural implements of the mound-builders. 304.
——*Scope and relationship of history and archaeology. 304.
HOSTETTER, J. C. The electrolytic reduction of iron for analysis. 429.
——*A method for the determination of magnesium in calcium salts. 522.
——*Densities at high temperatures. 521.
HOUGH, WALTER. *Savage mutilations for decoration. 200.
HOWARD, L. O. *Danger from imported plants and fruits, and government efforts to avoid it. 121.
HRDLICKA, ALES. *Results of a trip to Peru; with remarks on anthropological problems. 479.
HUMPHREYS, W. J. *Factors in climatic changes in the past. 299.
——*The 1912 excursion of the American Geographical Society. 47.
——*On the physics of the atmosphere. 333.
——Violent uprushes in cumulus clouds. 93.
——Volcanic dust as a factor in the production of climatic changes. 365.
HUNT, W. F. Triplite from eastern Nevada. 286.
——*Potassium ammonomagnesate and potassium ammonoborate. 130.
JOHANSEN, FRITZ. *Zoological results of the Denmark expedition to northeast Greenland. 268.
JOHNSON, W. T., JR. The destruction of bacteria in milk by ultra-violet rays. 160.
JOHNSTON, JOHN R. *History and cause of the coconut bud-rot. 26.
JOHNSTON, JOHN. *Note on the temperature in the deep boring at Findlay, Ohio. 500.
——*On the density of solid substances, with especial reference to permanent changes produced by high pressures. 113.
——*On the effect of high pressures on the physical and chemical behavior of solid substances. 165.
——*The general principles underlying metamorphic processes. 527.
KANOLT, C. W. The melting points of some refractory oxides. 315.
KEARNEY, THOMAS H. *Indicator value of natural vegetation in the Tooele Valley, Utah. 264.
——*The wilting coefficient for plants in alkali soils. 119.
KELLERMAN, KARL F. Suggestions for frost protection. 53.
KIMBALL, H. H. The unusual atmospheric haziness during the latter part of 1912. 269.
KINDLE, E. M. *The Onondaga fauna of the Allegheny Region. 403.
KNOPF, ADOLF. *The Eagle River region, southeastern Alaska. 258.
——*Ore deposits of the Helena mining region, Montana. 529.
KNOWLTON, F. H. *Effect of the Arctic night on tropical or subtropical vegetation. 380.
——*A paleobotanical study of the coal-bearing rocks of the Raton Mesa region of Colorado and New Mexico. 173.
KOLSTER, F. A. *National and international regulation of radiocommunication. 299.
LAMB, WM. H. *The catalpa septum: a factor in distinguishing hardy catalpa. 294.

* Abstracts.

——*A key to common Nebraska shrubs. 456.
——*The phylogeny of grasses. 119.
——*A synopsis of the red firs. 167.
LARSEN, E. S. Magnetite basalt from North Park, Colo. 449.
——*Mixtures of amorphous sulfur and selenium as immersion media for the determination of high refractive indices with the microscope. 114.
LATHROP, ELBERT C. *Chemical changes in heated soils. 261.
——*The chemistry of steam-heated soils. 256.
——*Guanine from a heated soil. 253.
——*Normal and abnormal constituents of soil organic matter. 252.
LECLERC, J. A. *Effect of lime upon the alkali tolerance of wheat seedlings. 197.
——*Influence of environment upon the composition of wheat. 262.
LEE, WILLIS T. *Coal fields of Grand Mesa and the West Elk Mountains, Colorado. 362.
——*Recent discovery of dinosaurs in the Tertiary. 173.
LEFFINGWELL, E. DEK. *Reconnaissance of the Arctic Slope of Alaska. 343.
LEONARD, A. G. *Bismark, N. Dak., folio. 466.
LEVERETT, FRANK. *Time relations of glacial lakes in the Great Lakes region. 237.
LEWIS, W. S. *Physical testing of cotton yarns. 167.
LEWTON, Frederick L. *Cotton of the Hopi Indians: a new species of Gossypium. 24.
——*Kokia: a new genus of Hawaiian trees. 25.
——*Rubelzul cotton: a new species of Gossypium from Guatemala. 24.
LILLIE, RALPH S. *Physico-chemical conditions of anesthetic action. 340.
LINDEMUTH, J. R. *Analysis of certain Pacific coast kelps. 262.
LOTKA, ALFRED J. A natural population norm. I. 241.
——A natural population norm. II. 289.
LOUGHLIN, G. F. *Reconnaissance in the Southern Wasatch Mountains. 50.
LYON, MARCUS, JR. *Tree-shrews. 268.
MADDREN, A. G. *Geology of the Koyukuk-Chandalar region, Alaska. 528.
MCCOLLUM, BURTON. *Electrolysis in plain and reinforced concrete. 361.
MCCURDY, GEORGE GRAVES. *Ancient man, his environment and his art. 307.
MCDANIELS, A. S. The silver voltameter. III. 40.
MCNEIL, H. C. *Moisture determination by means of calcium carbide. 129.
MARSH, C. D. *Stock poisoning by larkspur. 427.
MAXON, WM. R. A new genus of davallioid ferns. 143.
MERRIAM, C. HART. *Notes on the big bears of North America. 428.
——*Remarkable extinct fauna of southern California revealed in the asphalt deposits near Los Angeles. 428.
MERTIE, J. B., JR. *Igneous rocks of the Raton Mesa Region. 302.
MERWIN, H. E. Calcium vanadates from Peru, Colorado and Utah. 157.
——*Some special features of the glaciation of the Catskill Mountains. 539.

* Abstracts.

——*The simultaneous crystallization of calcite and certain sulfides of iron, copper and zinc. 504.
——*Two varieties of calciovolborthite (?) from eastern Utah. 503.
——Data on the intrusion temperature of the Palisade diabase. 389.
——Media of high refraction for refractive index determinations with the microscope; also, a set of permanent standard media of lower refraction. 35.
——*Media of high refraction for use with the microscope. 48.
——*Mixtures of amorphous sulfur and selenium as immersion media for the determination of high refractive indices with the microscope. 114.
——Two varieties of calciovolborthite (?) from eastern Utah. 138.
MOORE, RILEY B. *Observations in St. Lawrence Island. 129.
MOREY, GEORGE W. *The hydrothermal formation of silicates. 520.
MUELLER, E. F. *New calorimetric resistance thermometers. 296.
MULFORD, F. L. *Lawn soils and lawns. 254.
NELSON, E. K. *Tests for absinthe. 261.
NEWTON, PHILIP. *Negritos of the Philippines. 32.
NIGGLI, PAUL. *The general principles underlying metamorphic processes. 527.
——*The hydrothermal formation of silicates. 520.
——*The phenomena of equilibrium between silica and the alkali carbonates. 522.
NORTON, J. B. *Some interesting facts concerning the genus Asparagus. 132.
ORTON, W. A. Environmental influences in the pathology of Solanum tuberosum. 180.
OSBORNE, N. S. *Latent heat of fusion of ice. 453.
NUTTING, P. G. On the absorption of light in heterogeneous media. 322.
PAIGE, SIDNEY. *Bearing of Pre-Cambrian structure on the origin of the Homestake ore body. 173.
PALACHE, C. Hodgkinsonite, a new mineral from Franklin Furnace, N. J. 474.
PALMER, A. H. *Atmospheric humidity as related to haze, fog, and visibility at Blue Hill. 361.
PARKER, E. H. *Analysis of certain Pacific coast kelps. 262.
PARKER, G. H. *The sense of smell in fishes. 295.
PETERS, O. S. *Electrolysis in plain and reinforced concrete. 361.
PHALEN, W. C. *Kenova, Ky., West Virginia and Ohio, folio. 455.
PIPER, C. V. *The Filipinos and the problem of their government. 128.
POGUE, J. E. *Ores of the Mount Lyell copper district of Tasmania. 344.
PRIEST, IRWIN G. *A photometric error sometimes accompanying the use of a pair of nicols, and a proposal for its elimination. 298.
——*A simplified formula for the change in order of interference due to changes in temperature and pressure of air. 150.
RABAK, FRANK. *Some effects of refrigeration on sulfured and unsulfured hops. 120.
——*Wild volatile-oil plants and their economic importance. I. Black sage; II. Wild sage; III. Swamp bay. 23.
REID, F. R. *Studies in soil catalysis. 255.
RICHARDS, RALPH W. *Niter near Melrose, Mont. 301.
ROBINSON, W. O. *Manganese as a fertilizer. 255.

* Abstracts.

ROGERS, L. A. *Drying by the freezing method. 197.
ROHWER, S. A. *Sawflies and their relation to forestry. 175.
ROSA, E. B. *Electrolysis in plain and reinforced concrete. 361.
——The function of research in the regulation of natural monopolies. 201.
——The silver voltameter. III. 40.
ROSE, J. N. *A portrait of Linnaeus. 92.
SAFFORD, W. E. Chelonocarpus, a new section of the genus Annona, with descriptions of Annona scleroderma and Annona testudinea. 103.
——Pseudannona, a new genus of Annonaceae from the Mascarene Islands; together with notes on Artabotrys uncinatus and its synonymy. 16.
SALANT, W. *Concerning the pharmacological action of the tartrates 197.
SANSTROM, J. W. *Atmospheric studies. 110.
SCHALLER, WALDEMAR T. The calculation of mineral formulas. 97.
——*The crystallography of natramblygonite. 152.
——Hodgkinsonite, a new mineral from Franklin Furnace, N. J. 474.
——Immense bloedite crystals. 75.
——The refractive indices of strengite 249.
——*A study of the tourmaline group. 151.
SCHREINER, OSWALD. *The chemistry of steam-heated soils. 256.
——*Lawn soils and lawns. 254.
——*Problems of soil fertility. 260.
SEIDELL, A. *Seasonal variation in the iodine content of the thyroid gland. 131.
SHANTZ, H. L. *The water requirements of plants. 536.
SHAW, E. W. *Mud lumps at the mouth of the Mississippi. 343.
SHAW, HARRY B. *Control of seed production in beets. 264.
SHEAR, C. L. *Studies of fungous parasites belonging to the genus Glomerella. 194.
SHELDON, R. E. *The sense of smell in fishes. 295.
SHEPHERD, E. S. Water and the magmatic gases. 457.
SHOREY, E. C. *Recent work on the chemical composition of humus. 260.
——*Some organic soil constituents. 256.
SIEVERS, ARTHUR F. *A preliminary study of the forced curing of lemons as practiced in California. 25.
SINGEWALD, JOSEPH T., JR. *Relations of ilmenite to magnetite in titaniferous magnetite. 199.
SKEELS, H. C. *Method of types applied to the nickernut. 379.
SKINNER, J. J. *Beneficial effect of creatinine and creatine on growth. 254.
——*City street sweepings as a fertilizer. 254.
——*Effect of asparagin on absorption and growth in wheat. 255.
——*Effect of histidine and arginine as soil constituents. 253.
——*Influence of phosphate on the toxic action of cumarin. 253.
——*Lawn soils and lawns. 254.
——*Physiological action of certain organic soil constituents. 261.
SMITH, CLAYTON. *Concerning the pharmacological action of the tartrates. 197.
SMITH, HUGH M. *Recent progress in the study and culture of the common eel. 268.
SOSMAN, R. B. Data on the intrusion temperature of the Palisade diabase. 389.

* Abstracts.

——*Densities at high temperatures. 521.
——*La mesure des températures élevées par le thermomètre a gaz. 501.
——*The physical chemistry of Seger cones. 501.
SPENCER, ARTHUR C. Chalcocite deposition. 70.
SPURR, J. E. *Study of a contact metamorphic ore-deposit. The Dolores mine, at Matehuala, S. L. P. Mexico. 116.
STANTON, TIMOTHY W. Some variations in upper Cretaceous stratigraphy. 55.
STEIGER, GEORGE. Note on the analysis of water from a deep well in Pennsylvania. 423.
STOCKBERGER, W. W. *Some effects of refrigeration on sulfured and unsulfured hops. 120.
STOSE, GEORGE W. *Apishapa, Colo., Folio. 117.
——*Geology of the salt and gypsum deposits of southwestern Virginia. 117.
SULLIVAN, M. X. *Biochemical factors in soils. 252.
——*Manganese as a fertilizer. 255.
——*Origin of certain organic soil constituents. 260.
——*Studies in soil catalysis. 255.
SWANTON, JOHN R. *The Creek confederacy. 306.
SWICK, CLARENCE H. *Triangulation along the west coast of Florida. 500.
SWINGLE, WALTER T. The botanical name of the lime, Citrus aurantifolia. 463.
——Chaetospermum, a new genus of hard-shelled citrous fruits. 99.
——*Feroniella, genre nouveau de la tribu des Citreae, fondé sur le F. oblata, espèce nouvelle de l'Indo-Chine. 532.
——*Le fruit mûr et les jeunes semis de l' aeglopsis chevalieri. 504.
TASSIN, WIRT. *Rate of cooling in the green and its influence on the physical properties of annealed metals. 263.
TENNY, L. S. *Knot of citrus trees caused by Sphaeropsis tumefaciens. 29.
TILLYER, E. D. Determination of the zonal variation of the equivalent focus. 481.
TITTMANN, O. H. *Last meeting of the International Geodetic Conference at Hamburg. 48.
TOLMAN, L. M. *Study of changes taking place in the conversion of cider into vinegar. 130.
TRACY, S. M. *Rediscovery of Oenothera grandiflora. 175.
TRUE, RODNEY H. *Absorption and excretion of salts by roots, as influenced by concentration and composition of culture solutions. I. Concentration relations of dilute solutions of calcium and magnesium nitrate to pea roots. 26.
——*A preliminary study of the forced curing of lemons as practiced in California. 25.
TUTTLE, F. H. The determination of phosphorus in steels containing vanadium. 249.
VAN ORSTRAND, C. E. The determination of the order of agreement between observation and theory in mineral analyses. 223.
——Tables of the exponential function. 345.
VAUGHAN, THOMAS WAYLAND. *Remarks on the geology of the Bahama Islands, and on the formation of the Floridian and Bahaman oolites. 302.
VINAL, G. W. The silver voltameter. III. 40.

* Abstracts.

WAIDNER, C. W. Observations on ocean temperatures in the vicinity of icebergs and in other parts of the ocean. 405.
WALCOTT, CHARLES D. *Cambrian Brachiopoda. 336.
WALTENBURG, R. G. Melting points of the refractory elements. I. Elements of atomic weight from 48 to 59. 371.
WARD, ROBERT DE C. *Two climatic cross-sections of the United States. 334.
WASHINGTON, H. S. Magnetite basalt from North Park, Colo. 449.
——*The volcanic cycles in Sardinia. 526.
——*The volcanoes and rocks of Pantelleria. 502.
WEED, WALTER HARVEY. *Geology and ore deposits of the Butte district, Montana. 363.
WELLS, ROGER C. The interpretation of mineral analyses. 416.
——*Quantitative relations between oxidizing and reducing solutions. 342.
WETTENGEL, E. B. *Electrolytic determination of tin in canned food products. 131.
WHITE, WALTER P. New modified thermoelectric methods in calorimetry. 319.
WIEN, W. Recent theories of heat and radiation. 273.
WILDER, BURT G. *The brain as a guide to the affinities of vertebrates. 176.
WILLIAMS, TOM A. *The dream in the life of the mind. 155.
WILLIS, BAILEY. *Index to the stratigraphy of North America, with map compiled by Willis and Stose. 118.
WISSLER, CLARK. *Doctrine of evolution and anthropology. 155.
WOOD, ANNA K. *Studies of fungous parasites belonging to the genus Glomerella. 194.
WOODRUFF, E. G. *Cone in cone structure in coal from St. Anthony, Idaho. 237.
WOODWARD, R. S. *The laws of falling bodies. 426.
WOOLSEY, LESTER HOOD. *Geology and ore deposits of the Park City district, Utah. 445.
WRIGHT, FRED EUGENE. *Application of the microscope to physical problems. 48.
——*A graphical plot for use in the microscopical determination of the plagioclase feldspar. 525.
——*The index ellipsoid (optical indicatrix) in petrographic microscope work. 503.
——The change in the crystal angles of quartz with rise in temperature. 485.
——Calcium vanadates from Peru, Colorado and Utah. 157.
——The determination of the order of agreement between observation and theory in mineral analysis. 223.
——An electrical goniometer furnace for the measurement of crystal angles and of refractive indices at high temperatures. 396.
——*Graphical methods in microscopical petrography. 524.
——An improved vertical-illuminator. 14.
——*Microscopical petrography from the quantitative view-point. 115.
——A new thermal microscope for the measurement of the optical constants of minerals at high temperatures. 232.
——*Oblique illumination in petrographic microscope work. 525.

* Abstracts.

——*Petrographic study of the specimens of loess, tierra cocida, and scoria collected by the Hrdlicka-Willis Expedition. 115.

YODER, P. A. *Influence of environment upon the composition of wheat. 262.

SUBJECT INDEX

Agricultural Chemistry. *Analysis of certain Pacific coast kelps. PARKER and LINDEMUTH. 262.

*Chemical changes in heated soils. E. C. LATHROP. 261.

Chemistry of steam-heated soils. O. SCHREINER and E. C. LATHROP. 256.

*City street sweepings as a fertilizer. J. J. SKINNER and J. H. BEATTIE. 254.

*Constituents of soil organic matter. E. C. LATHROP. 252.

*Effect of asparagin on wheat. J. J. SKINNER and J. H. BEATTIE. 255.

*Effect of creatinine and creatine on growth. J. J. SKINNER. 254.

*Effect of lime upon the alkali tolerance of wheat seedlings. LECLERC and BREZEALE. 197.

*Guanine from a heated soil. E. C. LATHROP. 253.

*Histidine and arginine as soil constituents. J. J. SKINNER. 253.

*Influence of environment upon composition of wheat. LECLERC and YODER. 262.

*Influence of phosphate on the toxic action of cumarin. J. J. SKINNER. 253.

*Lawn soils and lawns. O. SCHREINER, J. J. SKINNER, L. C. CORBETT and F. L. MULFORD. 254.

*Manganese as a fertilizer. M. X. SULLIVAN and W. O. ROBINSON. 255.

*Organic soil constituents. E. C. SHOREY. 256.

*Origin of certain organic soil constituents. M. X. SULLIVAN. 260.

*Physiological action of certain organic soil constituents. J. J. SKINNER. 261.

*Problems in soil fertility. O. SCHREINER. 260.

*Soil catalysis. M. X. SULLIVAN and F. R. REID. 255.

Agriculture. *Control of seed production in beets. H. B. SHAW. 264.

*Indicator value of natural vegetation in the Tooele Valley, Utah. T. H. KEARNEY. 264.

—See also: Agricultural chemistry; Plant pathology.

American Geographical Society. *Excursion of 1912. W. J. HUMPHREYS. 47.

Anthropology. *Agricultural implements of the mound-builders. W. H. HOLMES. 304.

*Ancient man. G. G. MCCURDY. 307.

*Anthropological problems of Peru. A. HRDLICKA. 479.

*Creek confederacy. J. R. SWANTON. 306.

*Distribution of animals. A. H. CLARK. 196.

*Doctrine of evolution and anthropology. C. WISSLER. 155.

*Filipinos and the problem of their government. C. V. PIPER. 128.

*Race statistics of the last census. E. D. DURAND. 91.

*Siamese life and industries. J. H. GORE. 307.

*Savage mutilations for decoration. W. HOUGH. 200.

Archaeology. *Scope and relationship of history and archaeology. W. H. HOLMES. 304.

* Abstracts.

Astronomy. *Determination of time, longitude, latitude and azimuth. W. Bowie. 402.

Astrophysics. *Report, Astrophysical Observatory, Smithsonian Institution. C. G. Abbot. 110.

Variation of the sun. C. G. Abbot, F. E. Fowle and L. B. Aldrich. 309.

Bacteriology. *Attempts to transmit poliomyelitis. J. F. Anderson. 337.

Destruction of bacteria in milk. S. H. Ayers and W. T. Johnson, Jr. 160.

Bio-Chemistry. *Biochemical factors in soils. M. X. Sullivan. 252.

*Biochemical study of the curly-top of sugar beet. H. H. Bunzel. 251.

*Biochemistry of the banana. H. C. Gore. 342.

*Wild volatile-oil plants. F. Rabak. 23.

Botany. Botanical name of the lime. W. T. Swingle. 463.

*Catalpa septum. W. H. Lamb. 294.

Chaetospermum. W. T. Swingle. 99.

Chelonocarpus. W. E. Safford. 103.

*Cotton of the Hopi Indians. F. L. Lewton. 24.

*Diseases of trees caused by mistletoes. G. G. Hedgcock. 265.

*Effect of Arctic night on tropical or subtropical vegetation. F. H. Knowlton. 380.

*Genus Asparagus. J. B. Norton. 132.

*Feroniella, genre nouveau de la tribu des Citreae, fondé sur le F. oblata, espèce nouvelle de l'Indo-Chine. W. T. Swingle. 532.

*Identity of Oenothera Lamarckiana. H. H. Bartlett. 175.

Ivory palms in Panama. O. F. Cook. 138.

*Key to common Nebraska shrubs. W. H. Lamb. 456.

*Kokia: a new genus of Hawaiian trees. F. L. Lewton. 25.

*Le fruit mûr et les jeunes semis de l' Aeglopsis chevalieri. Walter T. Swingle. 504.

*Linnaeus, Portrait of. J. N. Rose. 92.

*Method of types applied to the nickernut. H. C. Skeels. 379.

Name for the sapote. O. F. Cook. 158.

New genus of Annonaceae. W. E. Safford. 16.

New genus of davallioid ferns. W. R. Maxon. 143.

New shrubby buckeye. W. W. Ashe. 424.

*Notes on the botany of Trinidad. A. S. Hitchcock. 266.

*Phylogeny of grasses. W. H. Lamb. 119.

*Rediscovery of Oenothera grandiflora. S. M. Tracy. 175.

*Rubelzul cotton. F. L. Lewton. 24.

*Synopsis of the red firs. W. H. Lamb. 167.

—See also: Plant physiology.

Cattle poisoning. *Stock poisoning by Larkspur. C. D. Marsh. 427.

Chemistry. *Action of potassium amide on cupric nitrate. H. C. Franklin. 334.

*Action of potassium amide on thallium nitrate. E. C. Franklin. 335.

Analysis of deep well water. G. Steiger. 423.

*Comparison of plant, meat, and yeast extracts. F. C. Cook. 131.

*Concentration of mineral waters in relation to their therapeutic activity. R. B. Dole. 130.

Determination of phosphorus in steels. J. R. Cain and F. H. Tuttle. 249.

* Abstracts.

*Drying by the freezing method. L. A. ROGERS. 197.
Electrolytic reduction of iron. J. C. HOSTETTER. 429.
*Estimation of tartaric and malic acids. H. C. GORE. 198.
*Incandescent gas lighting. S. GULBRANDSEN. 340.
Interpretation of mineral analyses. R. C. WELLS. 416.
*Method for the determination of magnesium in calcium salts. 522.
*Moisture determination by means of calcium carbide. H. C. MCNEIL. 129.
*Paladium hydrogenation. A. R ALBRIGHČ. 263.
*Pharmacological action of the tartrates. SALANT and SMITH. 197.
*Physico-chemical conditions of anesthetic action. R. S. LILLIE. 340.
*Potassium ammonomagnesate and potassium ammonoborate. E. C. FRANKLIN. 130.
*Potassium ammonotitanate. E. C. FRANKLIN and T. B. HINE. 335.
*Quantitative relations between oxidizing and reducing solutions. R. C. WELLS. 342.
*Rate of cooling in the green. W. TASSIN. 263.
*Seasonal variation in the iodine content of the thyroid gland. SEIDELL and FENGER. 131.
*Study of changes taking place in the conversion of cider into vinegar. L. M. TOLMAN. 130.
*Tests for absinthe. E. K. NELSON. 261.
—See also: Agricultural chemistry; Biochemistry; Electro chemistry; Geochemistry; Physical chemistry; Industrial chemistry; Organic chemistry.
Climatology. *Climatic cross-sections of the U. S. R. DE C. WARD. 234.
*Effect of the recent freeze in California. D. GRIFFITHS. 379.
Crystallography. The change in the crystal angles of quartz with rise in temperature. FRED E. WRIGHT. 485.
*The simultaneous crystallization of calcite and certain sulfides of iron, copper and zinc. H. E. MERWIN. 504.
Economic geology. *Commercial marbles of western Vermont. T. N. DALE. 152.
Economics. Regulation of natural monopolies. E. B. ROSA. 201.
Electricity. High-frequency ammeters. J. H. DELLINGER. 412.
*The analysis of alternating current waves by the method of Fourier, with special reference to methods of facilitating the computations. F. W. GROVER. 501.
Electrochemistry. *Electrolysis in plain and reinforced concrete. E. B. ROSA, B. MCCOLLUM and O. S. PETERS. 361.
*Electrolytic determination of tin in canned food products. CUSHMANN and WETTENGEL. 131.
The silver voltameter. E. B. ROSA, G. W. VINAL and A. S. MCDANIEL. 40.
Ethnography. *Negritos of the Philippines. 32.
Engineering. *Physical testing of cotton yarns. W. S. LEWIS. 167.
*Testing and properties of textile materials. Bureau of Standards Circular 41. 166.
References: 447.
Entomology. *Butterflies from eastern Massachusetts. A. H. CLARK. 404.
*Danger from imported plants and fruits. L. O. HOWARD. 121.
*Piccole note su degli Onychophora. A. H. CLARK. 456.

* Abstracts.

Geochemistry. Chalcocite deposition. A. C. SPENCER. 70.
*Sulfides of zinc, cadmium, and mercury. E. T. ALLEN and J. L. CRENSHAW. 114.
Geodesy. *Precise level net of the U. S. W. BOWIE. 298.
*California-Washington arc. A. L. BALDWIN. 402.
*Triangulation along the west coast of Florida. CLARENCE H. SWICK. 500.
Geography. *Biological paleogeography. A. H. CLARK. 167.
*Islands of Antillia. W. H. BABCOCK 31.
Geology. *Apishapa, Colo., Folio. G. W. STOSE. 117.
*Are quantitative physico-chemical studies of rocks practicable? ARTHUR L. DAY. 502.
*Arctic Slope of Alaska. E. DE K. LEFFINGWELL. 343.
*The volcanoes and rocks of Pantelleria. HENRY S. WASHINGTON. 502.
*Bismarck, N. Dak., folio. A. G. LEONARD. 466.
*Coal fields of Grand Mesa. W. T. LEE. 362.
*Cone in cone structure in coal from Idaho. E. G. WOODRUFF. 237.
*Eagle River region, Alaska. A. KNOPF. 258.
*Enrichment of sulfide ores. W. H. EMMONS. 454.
*Geology of the Bahama Islands. T. W. VAUGHAN. 302.
*Geology of the Koyukuk-Chandalar region, Alaska. A. G. MADDREN. 528.
*Igneous rocks of the Raton Mesa Region. J. B. MERTIE, JR. 302.
*Index to the stratigraphy of North America. B. WILLIS. 118.
*Kenova, Ky., West Virginia, and Ohio, folio. W. C. PHALEN. 455.
*Mud lumps at the mouth of the Mississippi. E. W. SHAW. 343.
*Niter near Melrose, Mont. R. W. RICHARDS. 301.
*Onondaga fauna. E. M. KINDLE. 403.
*Ore deposits of the Butte District, Mont. W. H. WEED. 363.
*Ore deposits of the Helena mining region, Montana. A. KNOPF. 529.
*Ore deposits of the Park City district, Utah. J. M. BOUTWELL. 445.
*Ores of the copper district of Tasmania. GILBERT and POGUE. 344.
*Origin of the Homestake ore body. S. PAIGE. 173.
*Petroleum near Cody, Wyo. D. F. HEWETT. 51.
*Quaternary problems of central Alaska. H. M. EAKIN. 301.
*Rampart Quadrangle, Alaska. H. M. EAKIN. 467.
*Reconnaissance of the lower Fraser River, B. C. N. L. BOWEN. 539.
*Relations of ilmenite to magnetite. J. T SINGEWALD, JR. 199.
*Salt and gypsum deposits of western Virginia. G. W. STOSE. 117.
*Secondary enrichment in silver. E. S. BASTIN. 52.
*Some special features of the glaciation of the Catskill Mountains. H. E. MERWIN. 539.
*Southern Wasatch mountains. 50.
*Structure map of the northern anthracite field. N. H. DARTON. 199.
*The general principles underlying metamorphic processes. J. JOHNSTON and P. NIGGLI. 527.
*The volcanic cycles in Sardinia. H. S. WASHINGTON. 526.
*Time relations of glacial lakes in the Great Lakes region. F. LEVERETT. 237.

* Abstracts.

Upper Cretaceous stratigraphy. T. W. STANTON. 55.
*Yentna District, Alaska. S. R. CAPPS. 466.
*Zinc-lead deposit, Nev. J. M. HILL. 238.
References: 447.
—See also: Economic geology; Petrology.
Geophysics. Data on Palisade diabase. R. B. SOSMAN and H. E. MERWIN. 389.
*Media of high refraction for use with the microscope. H. E. MERWIN. 48.
*Note on the temperature in the deep boring at Findlay, Ohio. JOHN JOHNSTON. 500.
Production of climatic changes. W. J. HUMPHREYS. 365.
*The hydrothermal formation of silicates, a review. G. W. MOREY and P. NIGGLI. 520.
*Water and magnetic gases. A. L. DAY and E. S. SHEPHERD. 457.
—See also: Hydrology; Oceanography.
Helminthology. Draconema. N. A. COBB. 145.
New nematode genera. N. A. COBB. 432.
Notes on Mononchus and Tylenchulus. N. A. COBB. 287.
Heredity. *Heredity and cotton breeding. O. F. COOK. 152.
Hydrology. References: 447, 535.
Ichthyology. *Alaska fisheries and fur industries in 1911. B. W. EVERMANN. 172.
*Sense of smell in fishes. G. H. PARKER and R. E. SHELDON. 295.
Industrial Chemistry. *Effect of certain pigments on linseed oil. E W. BOUGHTON. 257.
International Geodetic Conference. *Last meeting, at Hamburg. O. H. TITTMANN. 48.
Mathematics. Tables of the exponential function. C. E. VAN ORSTRAND. 345.
Useful type of formula. L. H. ADAMS. 469.
Medicine. *Ingenious method of causing death. A. H. CLARK. 196.
Metallography. An improved vertical-illuminator. F. E. WRIGHT. 14.
*Metallographic testing. Bureau of Standards Circ. 42. 251.
Note on ranges of pure iron. G. K. BURGESS and J. J. CROWE. 329.
References: 30.
Meteorology. Atmospheric haziness during 1912. H. H. KIMBALL. 269.
*Atmospheric humidity. A. H. PALMER. 361.
*Atmospheric studies. J. W. SANSTROM. 110.
*Factors in climatic changes in the past. W. J. HUMPHREYS. 299.
*Hurricanes of the West Indies. O. L. FASSIG. 333.
Influence of haze. L. J. BRIGGS and J. O. BELZ. 381.
*Physics of the atmosphere. W. J. HUMPHREYS. 333.
Violent uprushes in cumulus clouds. W. J. HUMPHREYS. 93.
Mineralogy. Calciovolborthite (?) from eastern Utah. W. F. HILLEBRAND. 138.
Calcium vanadates. W. F. HILLEBRAND, F. E. WRIGHT, and H. E. MERWIN. 157.
*The melting phenomena of the plagioclase feldspars. N. L. BOWEN. 523.
*Two varieties of calciovolborthite (?) from eastern Utah. W. F. HILLEBRAND and H. E. MERWIN. 503.
Calculation of mineral formulas. W. T. SCHALLER. 97.

* Abstracts.

*Crystallography of natramblygonite. W. T. SCHALLER. 152.
Hodgkinsonite. C. PALACHE and W. T. SCHALLER. 474.
Immense bloedite crystals. W. T. SCHALLER. 75.
Mineral analyses. F. E. WRIGHT and C. E. VAN ORSTRAND. 223.
Mineral separations. W. F. HILLEBRAND. 137.
Refractive indices of strengite. W. T. SCHALLER. 249.
*Tourmaline group. W. T. SCHALLER. 151.
Triplite from eastern Nevada. F. L. HESS and W. F. HUNT. 286.
Oceanography. Ocean temperatures. C. W. WAIDNER, H. C. DICKINSON and J. J. CROWE. 405.
*Sea water temperatures in the vicinity of icebergs. C. W. WAIDNER. 426.
*Salinity of surface water. A. H. CLARK. 165.
Organic chemistry. *Caffein in tea and coffee. H. C. FULLER. 342.
Paleontology. *Cambrian Brachiopoda. C. D. WALCOTT. 336.
*Cambrian Holothurians. A. H. CLARK. 530.
*Extinct fauna of southern California. C. H. MERRIAM. 428.
*Habitat of the Cambrian brachiopoda. L. D. BURLING. 199.
*Paleobotanical study of the coal-bearing rocks of the Raton Mesa region of Colorado and New Mexico. F. H. KNOWLTON. 173.
*Recent discovery of dinosaurs in the Tertiary. W. T. LEE. 173.
*Restoration of the genus Eldonia. A. H. CLARK. 167.
The systematic position of the crinoid family Plicatocrinidae. AUSTIN H. CLARK. 494.
Petrography. *Microscopical petrography from the quantitative viewpoint. F. E. WRIGHT. 115.
*Study of specimens of loess, tierra cocida, and scoria. F. E. WRIGHT and C. N. FENNER. 115.
Petrology. *A graphical plot for use in the microscopical determination of the plagioclase feldspar. F. E. WRIGHT. 525.
*Graphical methods in microscopical petrography. F. E. WRIGHT. 524.
—Magnetite basalt. H. S. WASHINGTON and E. S. LARSEN. 449.
*The index ellipsoid (optical indicatrix) in petrographic microscope work. FRED E. WRIGHT. 503.
*Oblique illumination in petrographic microscope work. F. E. WRIGHT. 525.
*Study of a contact metamorphic ore-deposit. J. E. SPURR, G. H. GARREY, and C. N. FENNER. 116.
Physical chemistry. *The Binary system. N. L. BOWEN. 380.
*Effect of high pressures on behavior of solid substances. J. JOHNSTON and L. H. ADAMS. 165.
*The phenomena of equilibrium between silica and the alkali carbonates. P. NIGGLI. 522.
*The physical chemistry of Seger cones. R. B. SOSMAN. 501.
Physics. Absorption of light. P. G. NUTTING. 322.
*Application of the microscope to physical problems. WRIGHT, BRIGGS, etc. 48.
Bismuth thermopiles. W. W. COBLENTZ. 357.
*Calibration of optical pyrometers. P. D. FOOTE. 151.
Constants of spectral radiation. W. W. COBLENTZ. 10, 177.
*Control of temperatures in an electric furnace. A. W. GRAY. 536.

* Abstracts.

*Densities at high temperatures. A. L. Day, R. B. Sosman and J. C. Hostetter. 521.
*Density of solid substances. J. Johnston and L. H. Adams. 113.
Determination of the zonal variation of the equivalent focus. E. D. Tillyer. 481.
*Determination of aqueous vapor. F. E. Fowle. 425.
*La mesure des températures élevées par le thermonêtre a gaz. Arthur L. Day and R. B. Sosman. 501.
A differential telethermograph. L. J. Briggs. 33.
Electrical goniometer furnace. F. E. Wright. 396.
*Fluidity and its relation to other physical and chemical properties. E. C. Bingham. 341.
High frequency resistances. L. W. Austin. 94.
*Latent heat of fusion of ice. H. C. Dickinson, D. R. Harper and N. S. Osborne. 453.
*Mechanical model of the least square adjustment. M. D. Hersey. 296.
Media of high refraction. H. E. Merwin. 35.
Melting points of the refractory elements. G. K. Burgess and R. G. Waltenburg. 371.
Melting points of refractory oxides. C. W. Kanolt. 315.
A micropyrometer. G. K. Burgess. 7.
*Mixtures of amorphous sulfur and selenium as immersion media for determination of high refractive indices. H. E. Merwin and E. S. Larsen. 114.
*New calorimetric resistance thermometers. Dickinson and Mueller. 296.
*New thermal microscope. F. E. Wright. 232.
*Photometric error sometimes accompanying the use of a pair of nicols. I. S. Priest. 298.
*Present status of the temperature scale. G. K. Burgess. 21.
Recent theories of heat and radiation. W. Wien. 273.
*Simplified formula for the change in order of interference due to changes in temperature and pressure of air. I. G. Priest. 150.
Suggestions for frost protection. K. F. Kellerman. 53.
Thermoelectric methods in calorimetry. W. P. White. 319.
References: 30.
——See also: Electricity; Electrochemistry; Geo-physics; Physical chemistry; Radiotelegraphy; Terrestrial magnetism.
Physiological botany. Formation of leaf-mold. F. V. Colville. 77.
Phytopathology. *Coconut bud-rot. J. R. Johnston. 26.
*Fungous parasites. C. L. Shear and A. K. Wood. 194.
*Knot of citrus trees caused by Sphaeropsis tumefaciens. F. Hedges and L. S. Tenny. 29.
Pathology of Solanum tuberosum. W. A. Orton. 180.
Plant physiology. *Absorption and excretion of salts by roots. R. H. True and H. H. Bartlett. 26.
*Effects of refrigeration on sulfured and unsulfured hops. W. W. Stockberger and F. Rabak. 120.
*Forced curing of lemons. A. F. Sievers and R. H. True. 25.
*Water requirements of plants. L. J. Briggs and H. L. Shantz. 536.
*Wilting coefficient for plants in alkali soils. T. H. Kearney. 119.
Psychopathology. *The dream in the life of the mind. T. A. Williams. 155.

* Abstracts.

Radiotelegraphy. Comparison of arc and spark sending apparatus. L. W. AUSTIN. 284.
Crystal contact disturbance preventer. L. W. AUSTIN. 386.
Further comparison of arc and spark radio transmission. L. W. AUSTIN. 517.
Radiotelegraphic signals. L. W. AUSTIN. 133.
*Recent experiments in radiotelegraphy. L. W. AUSTIN. 299.
*Regulation of intercommunication. F. A. KOLSTER. 299.
Signals in radiotelegraphy. L. W. AUSTIN. 326.
References: 30.
Railroads. *Work of Alaska Railroad Commission. A. H. BROOKS. 300.
Royal Society, London. 250th anniversary celebration. L. O. HOWARD. 121.
Statistics. References: 448.
Technology. *The metric carat. 533.
References: 535.
Terrestrial Magnetism. *The earth inductor as an inclinometer. N. E. DORSEY. 49.
Land magnetic observations, 1905-1910. L. A. BAUER. 20.
*New type of compass declinometer. R. L. FARIS. 112.
Origin of the Earth's magnetic field. L. A. BAUER. 1.
Preliminary results of a first analysis of the sun's general magnetic field. L. A. BAUER. 513.
Topography. *Physical aspects of Australia and New Zealand. J. BRYCE. 297, 339.
Vital Statistics. A natural population norm. A. J. LOTKA. 241, 289.
Weights and measures. *Types of false weights and measures found in U. S. 46.
Zoology. *American species of Peripatus. A. H. CLARK. 170.
*The brain as a guide to the affinities of vertebrates. B. G. WILDER. 176.
*Crinoids. A. H. CLARK. 168, 169, 170, 171, 294, 336, 456.
*A remarkable skeleton of Stegosaurus. C. W. GILMORE. 538.
*A revision of the crinoid family mariametridae. AUSTIN H. CLARK. 504.
*Revision of the crinoid genus Himerometra. A. H. CLARK. 533.
*Sawflies and their relation to forestry. S. A. ROHWER. 175.
*Study and culture of the common eel. H. M. SMITH. 268.
*Tree-shrews. M. LYON, JR. 268.
Web-spinning fly larvae. O. F. COOK. 190.
*Zoological results of the Denmark expedition. F. JOHANSEN. 268.
——See also: Entomology; Helminthology.

* Abstracts.